United States Department of Agriculture

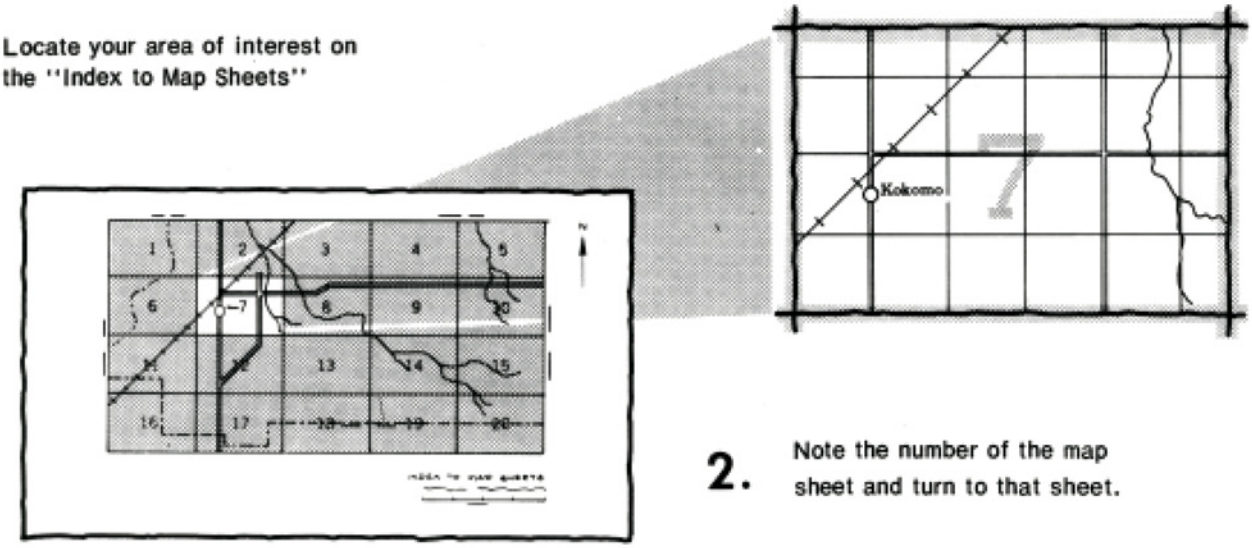
Soil Conservation Service

In cooperation with the South Dakota Agricultural Experiment Station

Soil Survey of Turner County South Dakota

HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"



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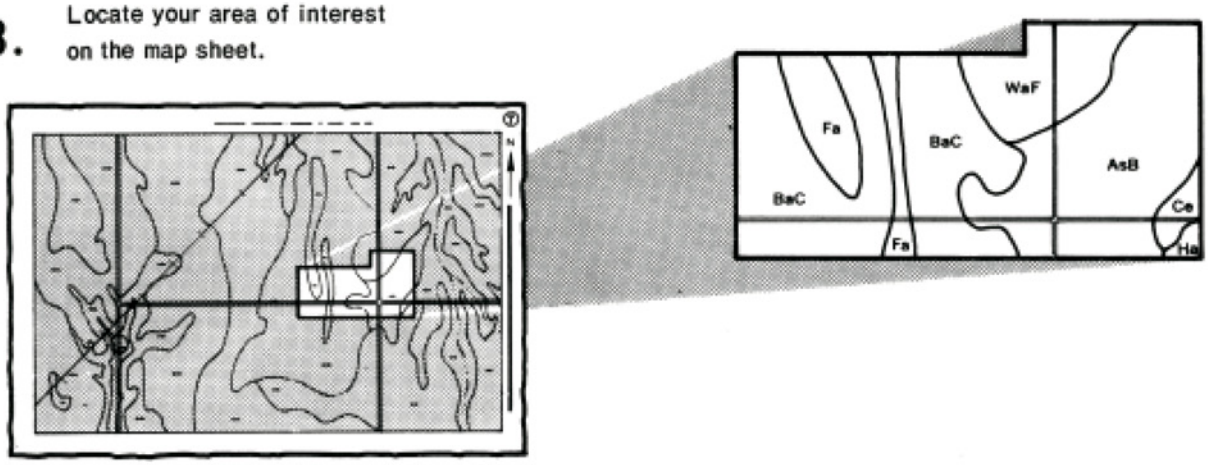

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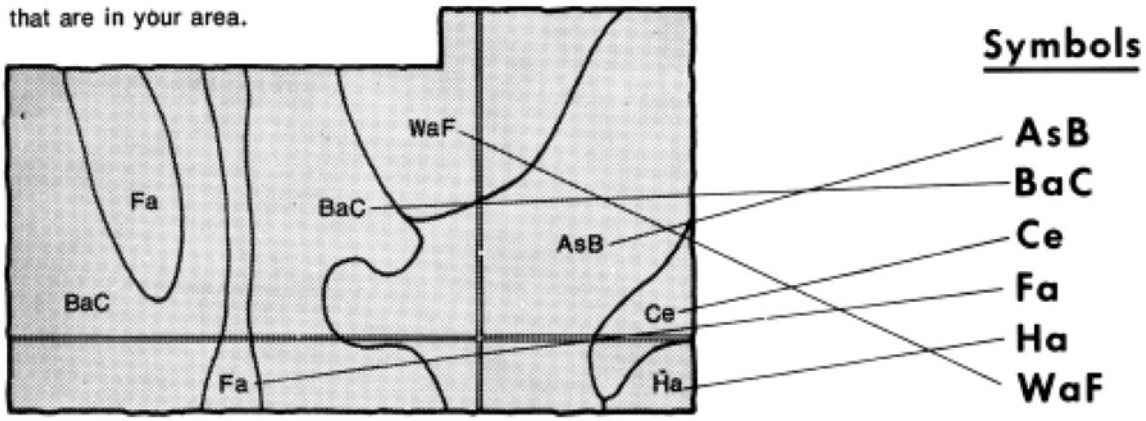
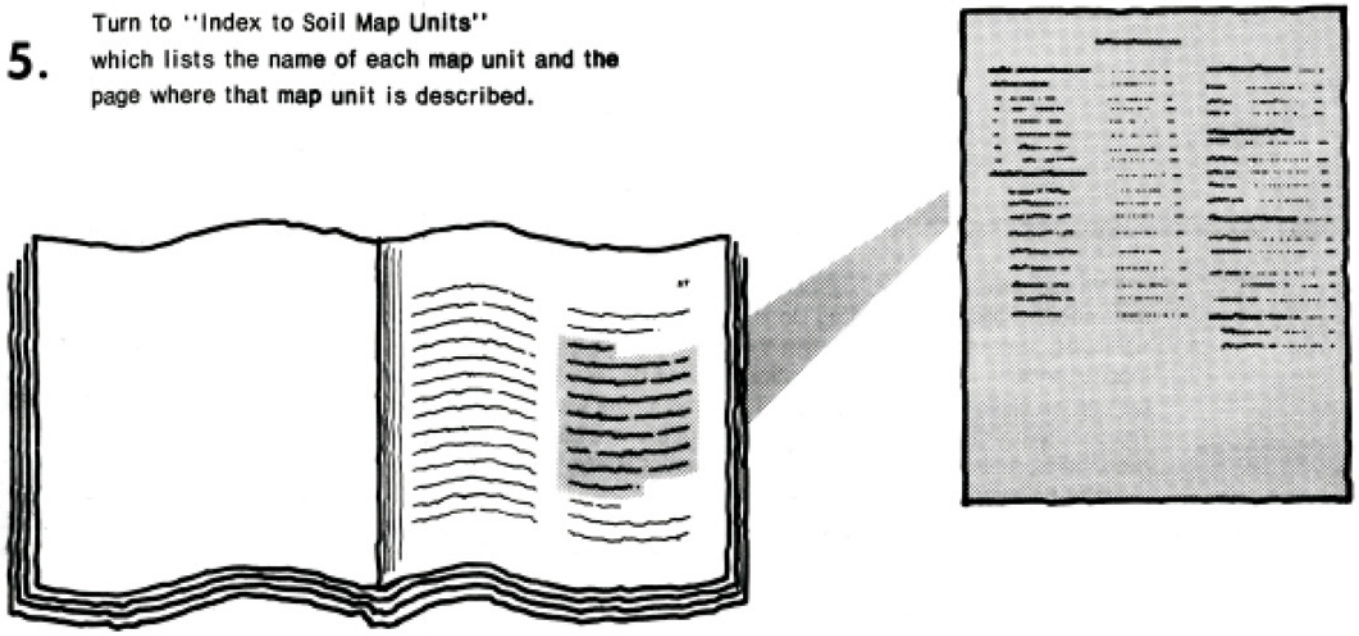
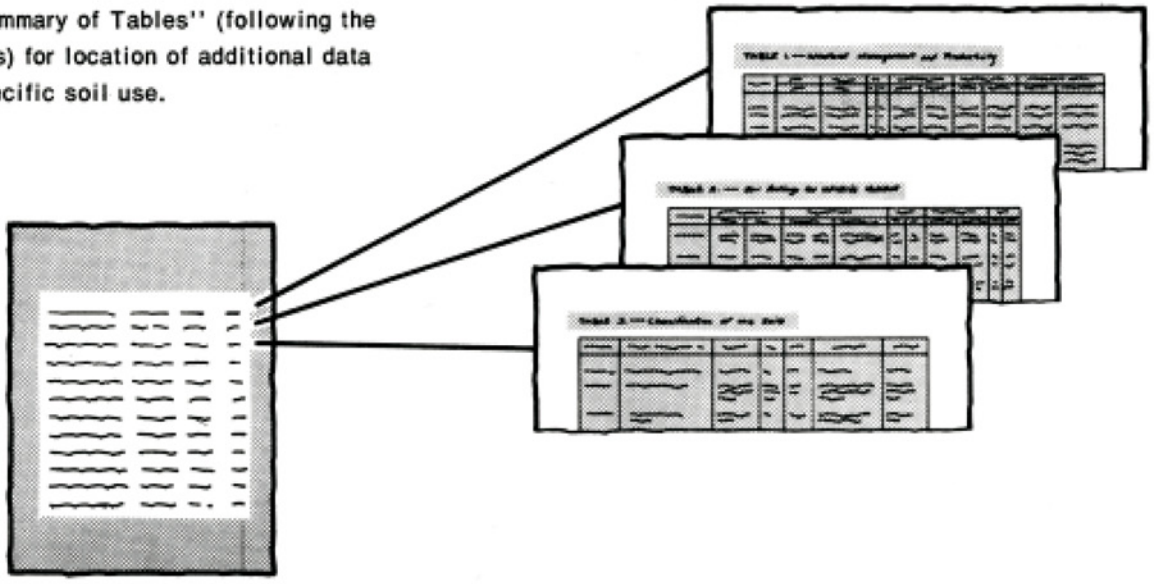


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service and the South Dakota Agricultural Experiment Station. It is part of the technical assistance furnished to the Turner County Conservation District. Financial assistance was furnished by the South Dakota Department of Revenue, the Turner County Commissioners, and the Old West Regional Commission. Major fieldwork was performed in the period 1976-80. Soil names and descriptions were approved in 1980. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1980.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover Farmstead on Clarno-Bonilla loams, 0 to 2 percent slopes.

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Foreword

This soil survey contains information that can be used in land-planning programs in Turner County, South Dakota. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations inherent in the soil or hazards that adversely affect the soil, improvements needed to overcome the limitations or reduce the hazards, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

R. D. Swenson
State Conservationist
Soil Conservation Service

soil survey of
Turner County, South Dakota

By Bruce O. Kunze, Soil Conservation Service

Soils surveyed by Bruce O. Kunze, Dennis M. Heil
and Wayne J. Bachman, Soil Conservation Service,
and Alan W. Hardison and Scott W. Anderson,
South Dakota State University

United States Department of Agriculture, Soil Conservation Service,
in cooperation with the South Dakota Agricultural Experiment Station

TURNER COUNTY is in the southeastern part of South Dakota (fig. 1). It has a total area of 391,680 acres, which includes about 460 acres of water. Parker is the county seat. Other towns and communities are Chancellor, Centerville, Davis, Dolton, Hurley, Marion, Monroe, and Viborg.

About 83 percent of the acreage in the county is cropland, and about 11 percent supports native grass (*3*). Corn, oats, soybeans, and alfalfa are the main crops.

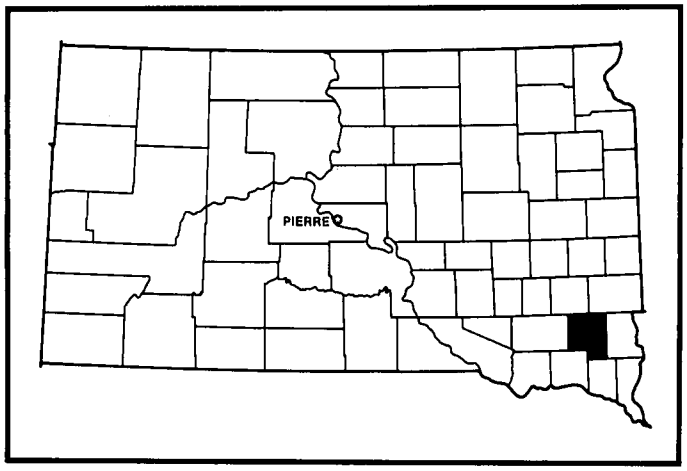

Figure 1.—Location of Turner County in South Dakota.

Farming is diversified; livestock and grain crops are the main sources of income.

general nature of the county

This section gives general information concerning the county. It describes climate; physiography, relief, and drainage; settlement; farming; and natural resources.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Turner County is usually warm in summer, but hot spells are frequent and cool days occasional. The county is very cold in winter, when arctic air frequently surges over the area. Most of the precipitation falls during the warm period, especially late in spring and early in summer. Snowfall is normally not heavy, and it is blown into drifts, so that much of the ground is free of snow.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Marion in the period 1951 to 1978. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 18 degrees F, and the average daily minimum temperature is 28 degrees. The lowest temperature on record, which occurred at Marion on January 1, 1974, is -31 degrees. In summer the average temperature is 72 degrees, and

the average daily maximum temperature is 85 degrees. The highest recorded temperature, which occurred at Marion on August 26, 1973, is 106 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 24.08 inches. Of this, 18 inches, or about 75 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 14 inches. The heaviest 1-day rainfall during the period of record was 3.96 inches at Marion on August 1, 1975. Thunderstorms occur on about 40 days each year, and most occur in summer.

Average seasonal snowfall is about 38 inches. The greatest snow depth at any one time during the period of record was 41 inches. On an average of 39 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 60 percent in winter. The prevailing wind is from the south in summer and the northwest in winter. Average windspeed is highest, 13 miles per hour, in spring.

physiography, relief, and drainage

Most of Turner County is on the James River Lowland (*4*), which is a nearly level to gently rolling glacial till and drift plain. The drainage pattern is poorly defined in areas where small drainageways terminate in depressions, but it is well defined along the larger drainageways. This area is drained by the East and West Forks of the Vermillion River and their tributaries.

"Turkey Ridge," in the southwestern part of the county, is on the James River Highlands. The landscape is an undulating and gently rolling glacial drift plain that is several hundred feet higher than the adjacent James River Lowland. The two principal drainageways are Turkey Ridge and Clay Creeks.

The northeastern part of the county is on the Coteau Des Prairies, which is an undulating to gently rolling glacial drift plain that has many small depressions. The drainage pattern is poorly defined in most areas but is well defined along the larger drainageways. The two principal drainageways are Beaver and Long Creeks.

Elevation ranges from 1,180 feet above sea level in the southeastern part of the county to about 1,640 feet in the northeastern part.

settlement

Turner County is named after John W. Turner, an early settler and onetime member of the Dakota Territorial Legislature (*5*). It was established by the Dakota Territorial Legislature in 1871. The original county included land now in Lincoln County and part of the former Jane County. Swan Lake was the first county seat. In 1885, Parker was selected as the county seat. The population of the county increased from 10,256 in 1890 to a high of 14,890 in 1930. It declined to 9,255 by 1980. According to the 1980 Census, Centerville has a population of 892, Chancellor has one of 257, Hurley has one of 419, Marion has one of 830, Monroe has one of 170, Parker has one of 999, and Viborg has one of 812.

Roads are on almost every section line. Most have a gravel or an asphalt surface. Most rural areas are served by all-weather roads to centers of trade.

farming

Farming is the principal enterprise in Turner County. About 73 percent of the farm income is derived from the sale of livestock and livestock products (*6*). About 14,000 acres of cropland is irrigated. In 1975, the 1,290 farms in the county averaged 290 acres in size. The trend is toward fewer and larger farms.

According to the South Dakota Crop and Livestock Reporting Service, about 135,000 acres was planted to corn in 1978, 85,000 acres to oats, 37,500 acres to soybeans, 3,900 acres to sorghum, 1,800 acres to barley, and 1,100 acres to wheat. The corn from 19,300 acres was harvested for silage. The rest was harvested for grain.

natural resources

Soil is the most important natural resource in Turner County. It provides a growing medium for crops and for the grasses grazed by livestock. Other natural resources are ground water, wildlife, and sand and gravel.

The principal source of water for domestic use and for livestock is shallow wells. Wells drilled to a depth of 400 to 600 feet also provide water. Dugouts in areas of Arlo, Baltic, Clamo, Dimo, Salmo, Tetonka, and Worthing soils provide additional water for livestock and wildlife. Dams constructed on small, deep drainageways also provide water for livestock. An aquifer between Parker and Davis provides sufficient water of good quality for irrigation. Wells dug in this aquifer range from 30 to 150 feet deep.

Significant deposits of sand and gravel are in areas of the Delmont-Enet association, which is described under the heading "General soil map units." Most of the sand and gravel has an excessive amount of fine rock fragments, such as shale, chalk, and clay ironstone, which make it unsuitable as concrete aggregate or as construction material. It is suitable, however, as

subgrade material for roads and as bituminous aggregate.

Cottontail, red fox, whitetail deer, and upland game birds, such as ring-necked pheasant, are the chief wildlife resources. The wetlands provide waterfowl production areas.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Many map units are made up of one kind of soil; however, in this county most are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland managers, engineers, planners, developers and builders, home buyers and others.

general soil map units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The 10 associations in this county have been grouped for broad interpretative purposes. The associations and the groups are described on the pages that follow. Because of differences in the detail of the general soil maps and changes in the application of the soil classification system, the names of the associations do not coincide exactly with those on the general soil maps in the published surveys of adjacent Clay, Hutchinson, Lincoln, McCook, Minnehaha, and Yankton Counties.

soil descriptions

Well drained to somewhat poorly drained soils on uplands, in upland swales, and in shallow upland drainageways

These soils dominantly are nearly level to undulating but are gently rolling to moderately steep along some drainageways. They make up about 33 percent of the county. About 84 percent of the acreage is cropland. Corn, oats, soybeans, and alfalfa are the main crops.

1. Clarno-Bonilla association

Well drained and moderately well drained, nearly level to gently rolling, loamy soils in convex areas and swales on uplands

This association is on uplands characterized by many shallow swales. The drainage pattern is well defined along the larger drainageways but is poorly defined in areas where drainageways terminate in small depressions. Slopes range from 0 to 9 percent.

This association makes up about 10 percent of the county. It is about 60 percent Clarno soils, 20 percent Bonilla soils, and 20 percent minor soils.

The well drained, nearly level to gently rolling Clarno soils are on convex parts of the landscape. Typically, the surface layer is very dark grayish brown loam. The subsoil is dark grayish brown, grayish brown, and light brownish gray clay loam. It is calcareous in the lower part. The underlying material is light yellowish brown and pale yellow, mottled, calcareous clay loam.

The moderately well drained, nearly level Bonilla soils are in swales. Typically, the surface layer is very dark gray loam. The subsoil is dark gray, grayish brown, and light brownish gray clay loam. It is calcareous in the lower part. The underlying material is light brownish gray, light yellowish brown, and light gray, mottled, calcareous clay loam.

Minor in this association are the somewhat poorly drained Crossplain soils in swales and drainageways; the moderately well drained, calcareous Davison soils on slight rises above the swales and depressions; the well drained, calcareous Ethan soils on knolls; and the poorly drained Tetonka soils in depressions.

About 90 percent of this association is cropland. Corn, small grain, soybeans, and alfalfa are the main crops. In the nearly level areas, these soils have few limitations. In the more sloping areas, controlling erosion is the main management concern. Conserving moisture also is a concern.

This association is well suited to cultivated crops, tame pasture and hay, range, and openland wildlife habitat. The Clarno soils are only fairly well suited to most kinds of building site development because of a moderate shrink-swell potential. They are only fairly well suited to septic tank absorption fields because of restricted permeability. The Bonilla soils generally are unsuitable as sites for buildings and septic tank absorption fields because they are subject to flooding.

2. Clarno-Crossplain-Davison association

Well drained to somewhat poorly drained, nearly level to undulating, loamy soils in convex areas, swales, and shallow drainageways on uplands

This association is on uplands characterized by gentle rises and many swales. The drainage pattern is poorly

defined. Many drainageways terminate in small depressions. Slopes generally are short and complex. They range from 0 to 6 percent.

This association makes up about 12 percent of the county. It is about 55 percent Clarno soils, 25 percent Crossplain soils, 10 percent Davison soils, and 10 percent minor soils (fig. 2).

The well drained and moderately well drained, gently undulating and undulating Clarno soils are on slight rises. Typically, the surface layer is very dark gray loam. The subsoil is dark grayish brown, grayish brown, and light brownish gray clay loam. It is calcareous in the lower part. The underlying material is light brownish gray, light gray, and light yellowish brown, mottled, calcareous clay loam.

The somewhat poorly drained, nearly level Crossplain soils are in swales and shallow drainageways. Typically, the surface layer is dark gray clay loam. The subsoil is

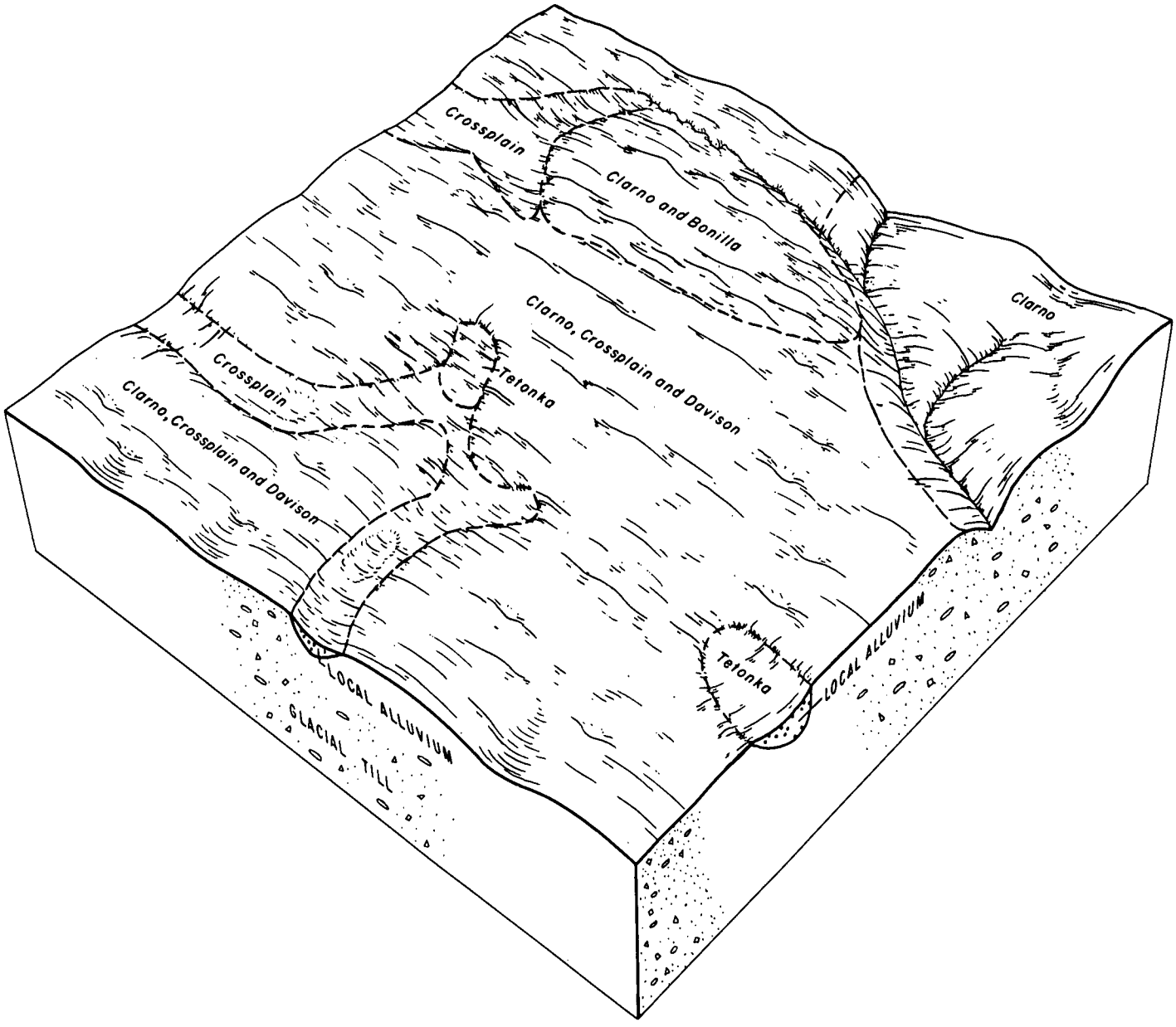

Figure 2.—Pattern of soils and parent material in the Clarno-Crossplain-Davison association.

dark gray, gray, and light brownish gray, mottled clay and clay loam. The underlying material is light brownish gray and light yellowish brown, mottled, calcareous clay loam.

The moderately well drained, gently undulating Davison soils occur as convex areas intermingled with areas of the Clarno soils above swales and depressions. Typically, the surface layer is dark grayish brown loam. The next layer is grayish brown clay loam. The underlying material is light yellowish brown clay loam. It is mottled and has accumulations of gypsum in the lower part. The soils are calcareous throughout.

Minor in this association are the moderately well drained Bonilla soils in swales and the poorly drained Tetonka and very poorly drained Worthing soils in depressions.

About 90 percent of this association is cropland. Corn, small grain, soybeans, and alfalfa are the main crops. The Clarno soils have few limitations. Controlling wetness on the Crossplain soils and improving fertility in the Davison soils are the main management concerns. Conserving moisture during dry periods also is a concern.

This association is well suited to cultivated crops, tame pasture and hay, range, and openland wildlife habitat. The Clarno soils are poorly suited to most kinds of building site development and sanitary facilities because of the wetness. The Crossplain and Davison soils generally are unsuitable as sites for buildings and sanitary facilities because of the wetness. Flooding also is a hazard on the Crossplain soils.

3. Clarno-Ethan association

Well drained, nearly level to moderately steep, loamy soils on uplands

This association is on uplands. The drainage pattern is well defined along the larger drainageways. It is poorly defined in areas where small drainageways terminate in small depressions. Slopes are dominantly 2 to 25 percent but range from 0 to 25 percent.

This association makes up about 11 percent of the county. It is about 50 percent Clarno soils, 25 percent Ethan soils, and 25 percent minor soils.

The nearly level to moderately sloping Clarno soils are on smooth side slopes. Typically, the surface layer is very dark gray loam. The subsoil is very dark grayish brown, grayish brown, and light gray clay loam. It is calcareous in the lower part. The underlying material is light gray and pale yellow, mottled, calcareous clay loam.

The undulating to moderately steep Ethan soils are on knolls and the upper side slopes. Typically, the surface layer is dark grayish brown loam. The next layer is light brownish gray clay loam. The underlying material is light gray and pale yellow, mottled clay loam. The soils are calcareous throughout.

Minor in this association are the moderately well drained Bonilla soils and the somewhat poorly drained Crossplain soils in swales and drainageways, the well drained Betts soils on the steeper sides of breaks along rivers and their tributaries, and the poorly drained Tetonka and very poorly drained Worthing soils in depressions.

About 80 percent of this association is cropland. Corn, small grain, soybeans, and alfalfa are the main crops. The steeper areas along drainageways support native grass and are used for grazing. Controlling erosion, conserving moisture, and improving fertility are the main concerns in managing the major soils for crops.

This association generally is well suited to cultivated crops and to tame pasture and hay, range, and openland and rangeland wildlife habitat in the less sloping areas. The major soils are only fairly well suited to most kinds of building site development because of a moderate shrink-swell potential and because of the slope in the steeper areas. They are only fairly well suited to septic tank absorption fields because of restricted permeability.

Well drained, moderately well drained, somewhat poorly drained, and very poorly drained soils on uplands and in swales, shallow drainageways, and depressions in the uplands

These soils dominantly are nearly level to gently rolling but are strongly sloping to moderately steep in some areas. They make up about 52 percent of the county. About 85 percent of the acreage is cropland. Corn, oats, soybeans, and alfalfa are the main crops.

4. Egan-Trent association

Well drained and moderately well drained, nearly level to undulating, silty soils on uplands and in upland swales

This association is on uplands characterized by many shallow swales. The drainage pattern is well defined along the larger drainageways. It is poorly defined in areas where small drainageways terminate in depressions. Slopes range from 0 to 6 percent.

This association makes up about 16 percent of the county. It is about 60 percent Egan soils, 15 percent Trent soils, and 25 percent minor soils.

The well drained, nearly level to undulating Egan soils are on the higher parts of the landscape. Typically, the surface layer is very dark gray silty clay loam. The subsoil is dark grayish brown, brown, and grayish brown silty clay loam and clay loam. It is calcareous in the lower part. The underlying material is light yellowish brown, mottled, calcareous clay loam.

The moderately well drained, nearly level Trent soils are in swales. Typically, the surface layer is very dark gray silty clay loam. The subsoil is very dark grayish brown, grayish brown, and light brownish gray, mottled silty clay loam. It is calcareous in the lower part. The

underlying material is light gray, mottled, calcareous silty clay loam.

Minor in this association are the somewhat poorly drained Chancellor soils in swales; the well drained, calcareous Ethan soils on knolls; the poorly drained Tetonka and very poorly drained Worthing soils in depressions; and well drained Wentworth soils in positions on the landscape similar to those of the Egan soils.

About 90 percent of this association is cropland. Corn, small grain, soybeans, and alfalfa are the main crops. In the nearly level areas, these soils have few limitations. In the undulating areas, controlling erosion is the main concern of management. Conserving moisture also is a concern.

This association is well suited to cultivated crops, tame pasture and hay, and openland wildlife habitat. The Egan soils are only fairly well suited to building site development because of a moderate shrink-swell potential. They are fairly well suited to most sanitary facilities. The Trent soils generally are unsuitable as sites for buildings and septic tank absorption fields because they are subject to flooding.

5. Wentworth-Chancellor-Wakonda association

Well drained to somewhat poorly drained, nearly level to undulating, silty soils in convex areas, swales, and shallow drainageways on uplands

This association is on uplands characterized by gentle rises and many swales. The drainage pattern is poorly defined. Many drainageways terminate in small depressions. Slopes range from 0 to 6 percent.

This association makes up about 12 percent of the county. It is about 40 percent Wentworth soils, 25 percent Chancellor soils, 15 percent Wakonda soils, and 20 percent minor soils.

The well drained and moderately well drained, nearly level to undulating Wentworth soils are on slight rises. Typically, the surface layer is very dark gray silty clay loam. The subsoil is dark grayish brown, grayish brown, and light brownish gray silty clay loam. It is calcareous and mottled in the lower part. The underlying material is pale yellow, mottled, calcareous silty clay loam and light gray, mottled, calcareous clay loam.

The somewhat poorly drained, nearly level Chancellor soils are in swales and shallow drainageways. Typically, the surface layer is very dark gray silty clay loam. The subsoil is very dark gray, dark gray, and light brownish gray silty clay and silty clay loam. It is mottled in the lower part. The underlying material is light yellowish brown and light gray, mottled, calcareous silty clay loam. It has accumulations of gypsum in the lower part.

The moderately well drained, nearly level Wakonda soils occur as areas intermingled with areas of the Wentworth soils above swales and depressions. Typically, the surface layer is dark gray silty clay loam. The next layer is dark gray and olive brown silty clay loam. The underlying material is light brownish gray silty clay loam, light yellowish brown loam, and pale yellow clay loam. It is mottled. It has accumulations of gypsum in the lower part. The soils are calcareous throughout.

Minor in this association are the well drained Egan soils in positions on the landscape similar to those of the Wentworth soils; the well drained, calcareous Ethan soils on knolls; the poorly drained Tetonka and very poorly drained Worthing soils in depressions; and the moderately well drained Trent soils in swales.

About 90 percent of this association is cropland. Corn, small grain, soybeans, and alfalfa are the main crops. Controlling wetness on the Chancellor soils and improving fertility in the Wakonda soils are the main management concerns. Conserving moisture also is a concern.

This association is well suited to cultivated crops, tame pasture and hay, and openland wildlife habitat. The Wentworth soils are poorly suited and the Chancellor and Wakonda soils generally unsuited to most kinds of building site development and sanitary facilities because of the wetness. Flooding also is a hazard on the Chancellor soils.

6. Egan-Ethan association

Well drained, nearly level to moderately steep, silty and loamy soils on uplands

This association is on uplands. The drainage pattern is well defined along the larger drainageways. It is poorly defined in areas where small drainageways terminate in small depressions. Slopes range from 0 to 25 percent.

This association makes up about 17 percent of the county. It is about 50 percent Egan soils, 30 percent Ethan soils, and 20 percent minor soils (fig. 3).

The nearly level to gently rolling Egan soils are on smooth side slopes. Typically, the surface layer is very dark gray silty clay loam. The subsoil is dark grayish brown, brown, and grayish brown silty clay loam and clay loam. It is calcareous in the lower part. The underlying material is light yellowish brown, mottled, calcareous clay loam.

The undulating to moderately steep Ethan soils are on knolls and the upper side slopes. Typically, the surface layer is dark grayish brown loam. The next layer is light brownish gray clay loam. The underlying material is light gray and pale yellow, mottled clay loam. The soils are calcareous throughout.

Minor in this association are the well drained Betts soils on the steeper sides of breaks along rivers and their tributaries, the poorly drained Tetonka and very poorly drained Worthing soils in depressions, the moderately well drained Trent and somewhat poorly drained Chancellor and Lamo soils in swales and shallow drainageways, and the well drained Wentworth

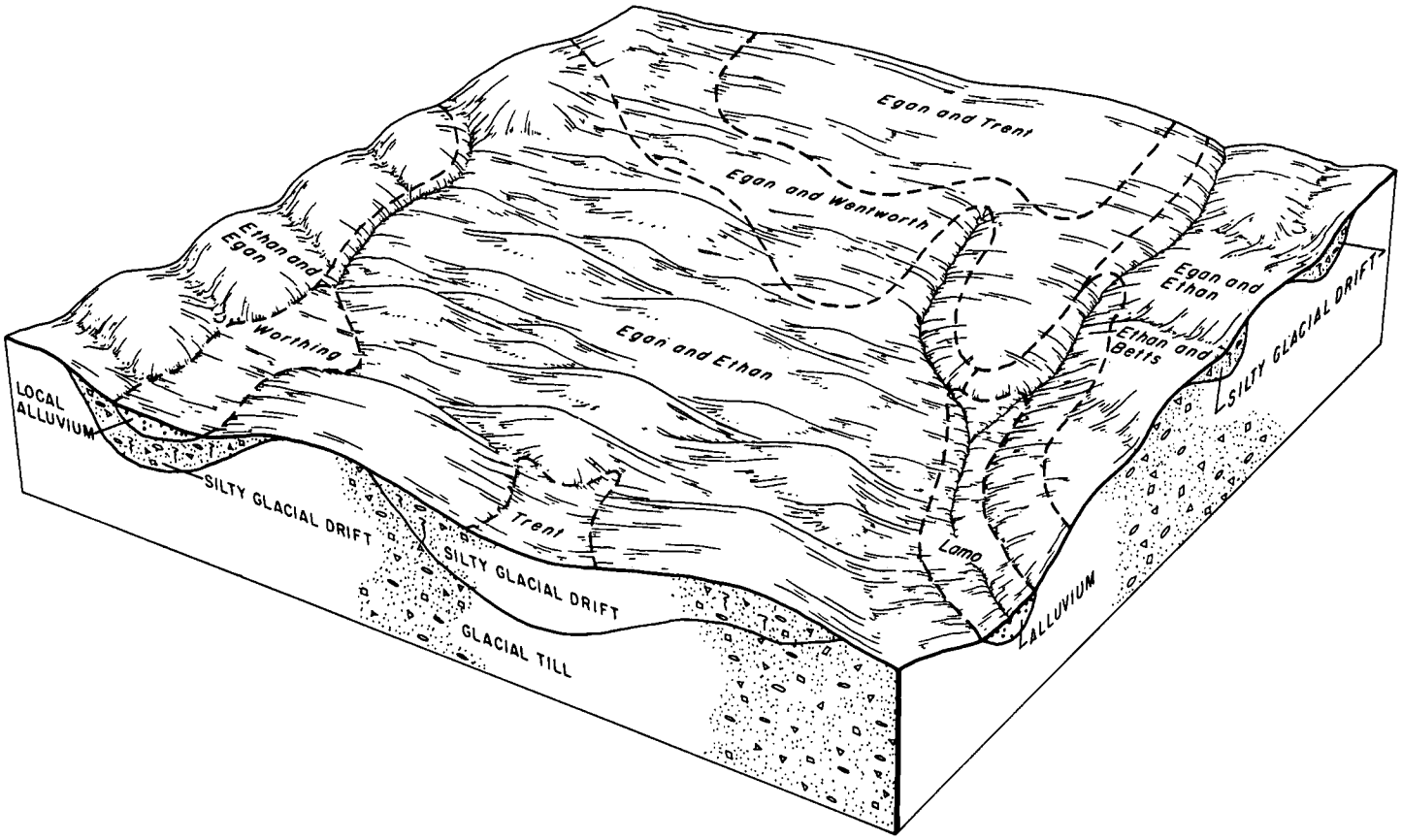

Figure 3.—Pattern of soils and parent material in the Egan-Ethan association.

soils in positions on the landscape similar to those of the Egan soils.

About 80 percent of this association is cropland. Corn, small grain, soybeans, and alfalfa are the main crops. The steeper areas along drainageways support native grass and are used for grazing. Controlling erosion, conserving moisture, and improving fertility are the main concerns in managing the major soils for crops.

This association generally is well suited to cultivated crops, tame pasture and hay, range, and openland and rangeland wildlife habitat in the less sloping areas. The major soils are only fairly well suited to most kinds of building site development because of a moderate shrink-swell potential and because of the slope in the steeper areas. They are only fairly well suited to septic tank absorption fields because of restricted permeability.

7. Egan-Worthing association

Well drained and very poorly drained, level to gently rolling, silty soils on uplands and in upland depressions

This association is on uplands characterized by many depressions. The drainage pattern is poorly defined, and drainageways generally terminate in depressions. Slopes generally are short and convex. They range from 0 to 9 percent.

This association makes up about 7 percent of the county. It is about 45 percent Egan soils, 15 percent Worthing soils, and 40 percent minor soils.

The well drained, nearly level to gently rolling Egan soils are on smooth side slopes. Typically, the surface layer is very dark gray silty clay loam. The subsoil is dark grayish brown, brown, and grayish brown silty clay loam and clay loam. It is calcareous in the lower part. The underlying material is light yellowish brown, mottled, calcareous clay loam.

The very poorly drained, level Worthing soils are in depressions. Typically, the surface layer is very dark gray silty clay loam. The subsoil is very dark gray, dark gray, and gray silty clay. It is calcareous in the lower part. The underlying material is light gray, mottled, calcareous silty clay loam.

Minor in this association are the very poorly drained Baltic and somewhat poorly drained Chaska soils on

flood plains, the well drained Betts and Ethan soils on knolls and the steeper side slopes, and the well drained Huntimer and Wentworth soils in positions on the landscape similar to those of the Egan soils.

About 65 percent of this association is cropland, but most areas of the Worthing soils are range and are used for grazing or wildlife habitat. Corn, small grain, soybeans, and alfalfa are the main crops. Controlling erosion and conserving moisture are the main management concerns on the Egan soils. The ponding is the main concern on the Worthing soils.

The Egan soils are well suited to cultivated crops, tame pasture and hay, range, and openland wildlife habitat. The Worthing soils are unsuited to cultivated crops and fairly well suited to tame pasture and hay and to range. They are well suited to wetland wildlife habitat. The Egan soils are only fairly well suited to most kinds of building site development because of a moderate shrink-swell potential. They are only fairly well suited to septic tank absorption fields because of restricted permeability. The Worthing soils generally are unsuitable as sites for buildings and sanitary facilities because of the ponding.

Well drained, somewhat poorly drained, and poorly drained soils on flood plains

These soils dominantly are nearly level but are gently sloping in some areas. They make up about 10 percent of the county. About 75 percent of the acreage is cropland. Corn, oats, soybeans, and alfalfa are the main crops.

8. Roxbury-Davis-Chaska association

Well drained and somewhat poorly drained, nearly level and gently sloping, silty and loamy soils on flood plains

This association is on flood plains that are dissected by deep channels. Slopes range from 0 to 6 percent.

This association makes up about 3 percent of the county. It is about 30 percent Roxbury soils, 25 percent Davis soils, 20 percent Chaska soils, and 25 percent minor soils (fig. 4).

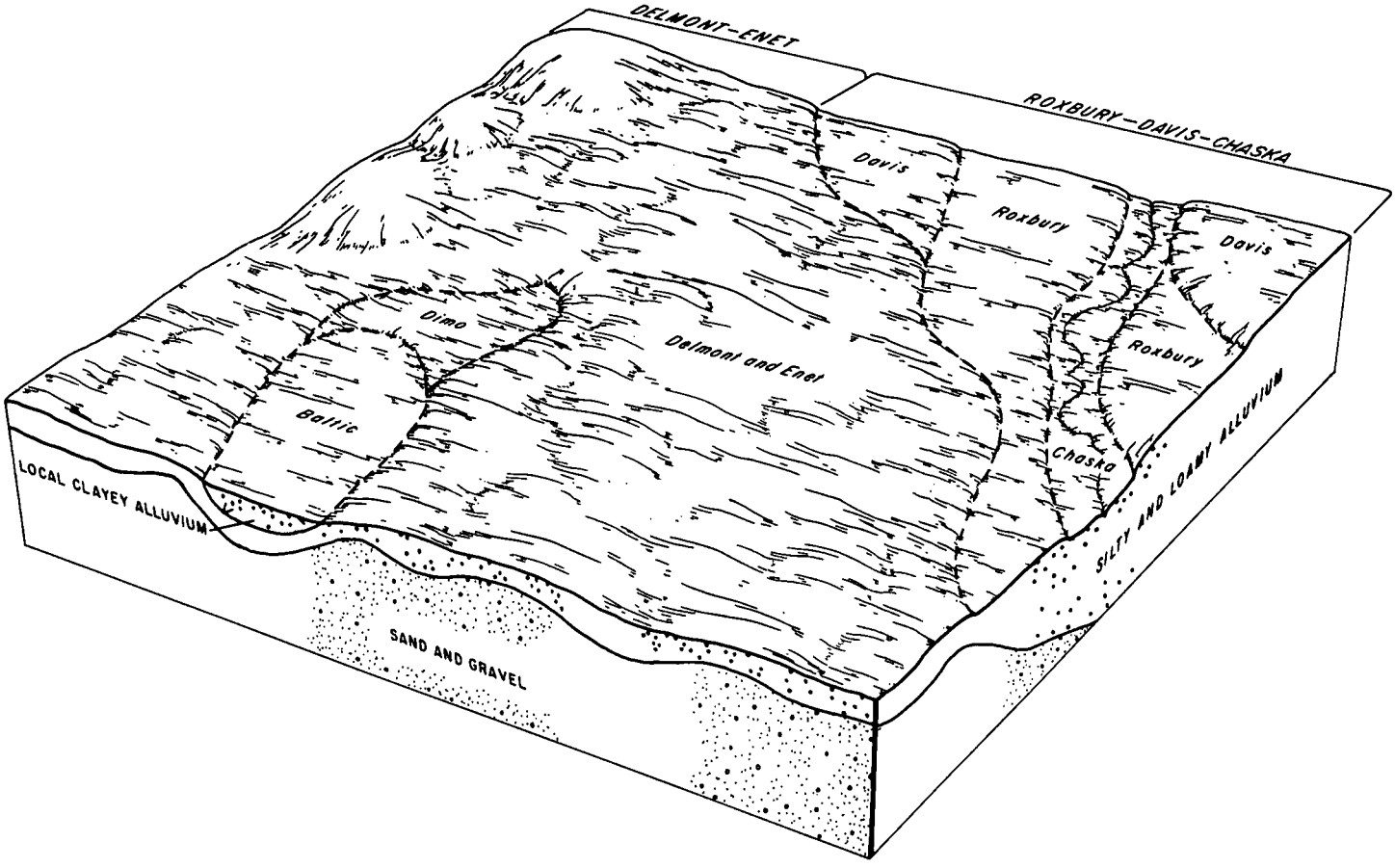

Figure 4.—Pattern of soils in the Roxbury-Davis-Chaska and Delmont-Enet associations.

The well drained, nearly level Roxbury soils are on the lower parts of the flood plains adjacent to the channels. Typically, the surface layer is dark gray silt loam. The subsoil is grayish brown silt loam. The underlying material is light brownish gray loam and silt loam stratified with thin layers of fine sandy loam.

The well drained, nearly level and gently sloping Davis soils are on the higher parts of the flood plain generally adjacent to the uplands. Typically, the surface layer is very dark gray loam. The subsurface layer is very dark gray silt loam. The subsoil is very dark gray and dark gray silt loam and loam. It is calcareous in the lower part. The underlying material is grayish brown, calcareous silt loam.

The somewhat poorly drained, nearly level Chaska soils are on low parts of the flood plains adjacent to the channels. Typically, the surface layer is dark gray loam. The underlying material is dark gray and gray stratified silt loam and loam.

Minor in this association are the poorly drained Clamo soils on the low parts of the flood plains and Delmont, Dimo, and Enet soils on terraces near the outer edges of the flood plains. Delmont, Dimo, and Enet soils are underlain by gravelly material.

About 75 percent of this association is cropland. Corn, small grain, soybeans, and alfalfa are the main crops. A few areas are irrigated. The channeled Chaska soils support native grass and in some areas native trees and shrubs. There are few limitations in managing the Roxbury and Davis soils for crops.

This association is well suited to cultivated crops and to tame pasture and hay, range, and openland and rangeland wildlife habitat. The Chaska and Roxbury soils generally are unsuited to building site development and sanitary facilities because they are subject to flooding. The areas of the Davis soils that are not subject to flooding are only fairly well suited to most kinds of building site development because of a moderate shrink-swell potential. They are only fairly well suited to septic tank absorption fields because of restricted permeability.

9. Clamo-Lamo association

Poorly drained and somewhat poorly drained, level and nearly level, clayey and silty soils on flood plains

This association is on flood plains that are dissected by a meandering channel. Slopes range from 0 to 2 percent.

This association makes up about 7 percent of the county. It is about 35 percent Clamo soils, 25 percent Lamo soils, and 40 percent minor soils.

The poorly drained, level Clamo soils are on the low parts of the flood plains. Typically, the surface layer is very dark gray silty clay. The subsoil is dark gray silty clay and silty clay loam. It is calcareous in the lower part. The underlying material is gray and light olive gray, mottled, calcareous silty clay loam.

The somewhat poorly drained, nearly level Lamo soils are higher on the flood plains than the Clamo soils. Typically, the surface layer is very dark gray silty clay loam. The subsurface layer is dark gray silty clay loam. The next layer also is dark gray silty clay loam. The underlying material is light brownish gray and gray, mottled silty clay loam. It has accumulations of gypsum. The soils are calcareous throughout.

Minor in this association are the poorly drained Arlo and very poorly drained Baltic soils on the low parts of the flood plains, the well drained Roxbury soils on the high parts of the flood plains, the somewhat poorly drained Chaska soils in shallow drainageways, and the somewhat poorly drained Dimo and poorly drained Salmo soils in positions on the landscape similar to those of the Clamo and Lamo soils. Dimo soils are underlain by gravelly material. Salmo soils have visible salts at or near the surface.

About 75 percent of this association is cropland. Some areas support native grass and are used for grazing or wildlife habitat. Corn, small grain, soybeans, and alfalfa are the main crops. Controlling wetness is the main concern in managing the major soils for crops. Improving tilth also is a concern.

This association is well suited to cultivated crops, range, tame pasture and hay, and openland wildlife habitat. It is only fairly well suited to rangeland wildlife habitat. The major soils are generally unsuited to buildling site development and sanitary facilities because of the flooding and the wetness.

Somewhat excessively drained and well drained soils on terraces

These soils dominantly are nearly level but are undulating in some areas. They make up about 5 percent of the county. About 80 percent of the acreage is cropland. Some areas are irrigated. Corn, oats, soybeans, and alfalfa are the main crops.

10. Delmont-Enet association

Somewhat excessively drained and well drained, nearly level to undulating, loamy soils on terraces

This association is on terraces. The drainage pattern is poorly defined in most areas. Slopes range from 0 to 6 percent.

This association makes up about 5 percent of the county. It is about 45 percent Delmont soils, 35 percent Enet soils, and 20 percent minor soils (fig. 4).

The somewhat excessively drained Delmont soils are on the middle and upper, plane and convex side slopes. Typically, the surface layer is very dark gray loam. The subsoil is very dark grayish brown loam. The underlying material is multicolored, calcareous gravelly sand.

The well drained Enet soils are on the smooth lower side slopes and in swales. Typically, the surface layer is very dark gray loam. The subsoil is very dark grayish

brown and dark grayish brown loam and fine sandy loam. The underlying material is grayish brown, calcareous gravelly loamy sand and multicolored, calcareous gravelly sand.

Minor in this association are the very poorly drained Baltic soils in depressions, the well drained Blendon soils in positions on the landscape similar to those of the Delmont and Enet soils, the well drained Davis and Roxbury soils on flood plains, and the somewhat poorly drained Dimo soils in swales.

About 80 percent of this association is cropland. Corn, small grain, soybeans, and alfalfa are the main crops. Much of the acreage is irrigated. Some areas support native grass and are used for grazing. Conserving moisture and controlling erosion in the undulating areas are the main concerns in managing the major soils for crops.

This association is only fairly well suited to cultivated crops and tame pasture and hay because the soils are droughty. It is well suited to most kinds of building site development. The major soils are poorly suited to sanitary facilities because of a poor filtering capacity and the likelihood of seepage. They are a probable source of sand and gravel for use as road construction material.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and identifies the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Davis loam, 0 to 2 percent slopes, is one of several phases in the Davis series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils that occur as areas so intricately mixed or so small that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Ethan-Egan complex, 2 to 6 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. These dissimiliar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

The names of some map units identified on the detailed soil maps do not fully agree with those identified on the maps in the published surveys of Clay, Hutchinson, Lincoln, McCook, Minnehaha, and Yankton Counties. Differences are the result of variations in the design and composition of map units or changes in the application of the soil classification system.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

soil descriptions

Ac—Alcester silt loam. This deep, moderately well drained, nearly level soil is on foot slopes and alluvial fans. It is occasionally flooded. Areas are 5 to more than 500 acres in size and are long and narrow.

Typically, the surface layer is dark gray silt loam about 10 inches thick. The subsurface layer is dark gray silty clay loam about 7 inches thick. The subsoil is friable, dark grayish brown and pale brown silty clay loam about 29 inches thick. The underlying material to a depth of 60 inches is light yellowish brown silty clay loam and silt loam. In some areas the subsoil and underlying material contain more sand. In other areas the depth to free carbonates is 20 to 36 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Chancellor and Lamo soils. These soils make up less than 10 percent of any one mapped area. They are in positions on the landscape similar to those of the Alcester soil.

The content of organic matter and fertility are high in the Alcester soil. Permeability is moderate. Available water capacity is high. A seasonal high water table is at a depth of 3 to 6 feet during wet periods. Runoff is slow.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. It has few limitations. Alfalfa, Garrison creeping foxtail, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants. In some years fieldwork is delayed because of runoff from adjacent soils, but in most years the additional moisture is beneficial.

This soil is well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs grow well, especially those that require an abundant moisture supply.

This soil generally is unsuitable as a site for buildings and sanitary facilities because of the flooding and the wetness.

The capability unit is I-1; Overflow range site.

Ar—Arlo clay loam. This poorly drained, nearly level soil is on flood plains. It is frequently flooded for brief periods after heavy rainfall or rapid snowmelt. It is moderately deep over gravelly material. Areas range from 10 to more than 500 acres in size and are irregular in shape.

Typically, the surface layer is dark gray clay loam about 11 inches thick. The next 7 inches is gray, friable loam. The upper part of the underlying material is light gray and light brownish gray, mottled sandy clay loam. The lower part to a depth of 60 inches is light olive brown and light gray, mottled gravelly sand and loamy sand. The soil is calcareous throughout.

Included with this soil in mapping are small areas of Baltic, Clamo, Dimo, and Salmo soils. These soils make up less than 15 percent of any one mapped area. They are in positions on the landscape similar to those of the Arlo soil. They contain less calcium carbonate within a depth of 16 inches than the Arlo soil. Also, Baltic and Clamo soils contain more clay throughout and are more than 40 inches deep to gravelly material. Salmo soils have visible salts at or near the surface.

The content of organic matter is moderate and fertility medium in the Arlo soil. Permeability is moderate in the upper part of the soil and rapid in the underlying gravelly material. Available water capacity is moderate. A seasonal high water table is within a depth of 2 feet in the spring of most years. Runoff is slow. The shrink-swell potential is moderate in the upper part of the soil and low in the underlying material.

Most of the acreage is cropland. This soil is fairly well suited to cultivated crops and to tame pasture and hay. Examples of suitable pasture plants are alfalfa, Garrison creeping foxtail, intermediate wheatgrass, reed canarygrass, and smooth bromegrass. Because of the wetness, late planted crops are better suited than early planted crops. The availability of plant nutrients is adversely affected by the high content of lime. Fieldwork is delayed in some years because of the wetness and the flooding. Installing a drainage system helps to control the wetness. Leaving crop residue on the surface improves fertility and helps to control wind erosion.

This soil is well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs grow well, especially those that require an abundant moisture supply.

This soil generally is unsuitable as a site for buildings and sanitary facilities because of the flooding and the wetness. It is a probable source of sand and gravel for use as road construction material.

The capability unit is IIIw-3; Subirrigated range site.

Ba—Baltic silty clay loam. This deep, very poorly drained, level soil is on flood plains and in depressions in the uplands. It is ponded after heavy rainfall or rapid snowmelt. Areas are 5 to several hundred acres in size and are circular or long and narrow.

Typically, the surface layer is very dark gray silty clay loam about 12 inches thick. The subsoil is very dark gray, firm silty clay about 20 inches thick. The underlying material to a depth of 60 inches is dark gray, mottled silty clay. It has accumulations of gypsum crystals. The soil is calcareous throughout. In some areas the content of clay is lower throughout the profile. In places sand and gravel are below a depth of 40 inches.

Included with this soil in mapping are small areas of Chancellor, Crossplain, Davison, Wakonda, and Salmo soils. These soils make up less than 15 percent of any one mapped area. The somewhat poorly drained Chancellor and Crossplain soils are slightly higher on the landscape than the Baltic soil. The moderately well drained Davison and Wakonda soils have a higher content of lime within a depth of 16 inches than the Baltic soil. They are on slight rises above the Baltic soil. Salmo soils have visible salts at or near the surface. They are in positions on the landscape similar to those of the Baltic soil.

The content of organic matter and fertility are high in the Baltic soil. Permeability is slow. Available water capacity is high. A seasonal high water table is within a depth of 2 feet most of the year. As much as 1 foot of water ponds on the surface during some wet periods. Runoff is ponded. The shrink-swell potential is high.

Most of the acreage is used for range or tame pasture and hay. Some areas are drained and used as cropland. This soil is fairly well suited to range. The native vegetation dominantly is slough sedge, northern reedgrass, and rivergrass. After continued overuse, these species lose vigor and are replaced by spikesedge and other less palatable species. Garrison creeping foxtail and reed canarygrass are suitable pasture plants.

If drained, this soil is fairly well suited to cultivated crops and to windbreaks and environmental plantings. In many areas, however, it cannot be drained because of a lack of suitable outlets. The trees and shrubs that require an abundant moisture supply grow especially well.

This soil generally is unsuitable as a site for buildings and most sanitary facilities because of the ponding.

The capability unit is Vw-2; Shallow Marsh range site.

Bb—Baltic silty clay loam, ponded. This deep, very poorly drained, level soil is on flood plains and in depressions in the uplands. It is ponded most of the year. Areas are 5 to several hundred acres in size and are oval.

Typically, the surface layer is very dark gray silty clay loam about 18 inches thick. The subsoil is about 31 inches of very dark gray and gray, firm silty clay and clay. The underlying material to a depth of 60 inches is light gray and pale olive, mottled silty clay loam. The soil is calcareous throughout. In places free carbonates are leached to a depth of 35 inches or more. In some areas the soil contains less clay. In other areas sand and gravel are below a depth of 40 inches.

Included with this soil in mapping are small areas of Davison, Salmo, and Wakonda soils. These soils make up less than 10 percent of any one mapped area. The moderately well drained Davison and Wakonda soils have a higher content of lime within a depth of 16 inches than the Baltic soil. They are on slight rises above the Baltic soil. Salmo soils have visible salts at or near the surface. They are in positions on the landscape similar to those of the Baltic soil.

The content of organic matter and fertility are high in the Baltic soil. Permeability is slow. Available water capacity is high. As much as 2 feet of water ponds on the surface during wet periods. Runoff is ponded. The shrink-swell potential is high.

Most areas are used as wildlife habitat (fig. 5). This soil is well suited to wetland wildlife habitat. The native vegetation is mainly aquatic plants, such as rushes, cattails, and sedges. Establishing level ditches, shallow pits, and other areas where water can accumulate enhances the habitat for wetland wildlife.

This soil is unsuited to cultivated crops, tame pasture and hay, and windbreaks and environmental plantings. It is unsuitable as a site for buildings and most sanitary facilities because of the ponding.

The capability unit is VIIIw-1; no range site is assigned.

BeE—Betts-Ethan loams, 15 to 40 percent slopes. These deep, well drained, moderately steep and steep soils are on uplands that generally are dissected by well defined drainageways. They are on breaks along the

Figure 5.—An area of Baltic silty clay loam, ponded, used as habitat for wetland wildlife.

major streams and their tributaries. The Betts soil is on the upper parts of the slopes and on ridgetops. The Ethan soil is on the mid and lower side slopes. Few to many scattered stones are on the surface. Areas are 5 to more than 1,000 acres in size and are irregular in shape. They are 60 to 70 percent Betts soil and 25 to 35 percent Ethan soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Betts soil is dark grayish brown loam about 4 inches thick. The next 5 inches is grayish brown, friable clay loam. The underlying material to a depth of 60 inches is light brownish gray, mottled clay loam. The soil is calcareous throughout.

Typically, the surface layer of the Ethan soil is very dark gray loam about 8 inches thick. The next 13 inches is light brownish gray, friable, calcareous clay loam. The underlying material to a depth of 60 inches is light gray and pale yellow, calcareous clay loam. In places the depth to free carbonates is more than 9 inches.

Included with these soils in mapping are small areas of Chaska, Davis, and Talmo soils. These included soils make up less than 15 percent of any one mapped area. Chaska and Davis soils are dark to a depth of more than 20 inches. The somewhat poorly drained Chaska soils are in drainageways. Davis soils are on fans and foot slopes. Talmo soils have sand and gravel within a depth of 14 inches. They are in positions on the landscape similar to those of the Betts soil.

The content of organic matter and fertility are low in the Betts and Ethan soils. Permeability is moderate in the upper part of the profile and moderately slow in the underlying material. Available water capacity is high. Runoff is rapid. The shrink-swell potential is moderate.

Most of the acreage supports native grasses. These soils are fairly well suited to range. The native vegetation dominantly is little bluestem, needlegrass, and sideoats grama. Overused areas are dominated by blue grama, needleandthread, Kentucky bluegrass, and annual grasses and weeds.

These soils generally are too steep for cultivated crops, tame pasture and hay, windbreaks and environmental plantings, building site development, and sanitary facilities.

The Betts soil is in capability unit VIIe-1, Thin Upland range site; the Ethan soil is in capability unit VIe-3, Silty range site.

BhE—Betts-Talmo complex, 12 to 40 percent slopes. These strongly sloping to steep soils are on uplands that in some areas are dissected by well defined drainageways. They are on breaks along the major streams and their tributaries. The Betts soil is deep and well drained. The excessively drained Talmo soil is very shallow over sand and gravel. It occurs as small scattered areas on knolls. In some areas few to many scattered stones are on the surface. Areas are 10 to more than 500 acres in size and are irregular in shape. They are about 65 to 75 percent Betts soil and 10 to 20 percent Talmo soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Betts soil is dark grayish brown loam about 4 inches thick. The next 5 inches is grayish brown, friable clay loam. The underlying material to a depth of 60 inches is light brownish gray, mottled clay loam. The soil is calcareous throughout.

Typically, the surface layer of the Talmo soil is very dark gray gravelly loam about 7 inches thick. The underlying material to a depth of 60 inches is multicolored gravelly loamy sand and very gravelly sand. The soil is calcareous throughout.

Included with these soils in mapping are small areas of Clarno, Davis, and Delmont soils. These included soils make up less than 15 percent of any one mapped area. Clarno and Davis soils are lower on the landscape than the Betts and Talmo soils. Also, Clarno soils are leached of free carbonates to a greater depth than the Betts soil and have a thicker surface layer. Davis soils are dark to a depth of more than 20 inches. Delmont soils are underlain by gravelly material at a depth of 14 to 20 inches. They are in positions on the landscape similar to those of the Talmo soil.

The content of organic matter and fertility are low in the Betts and Talmo soils. Permeability is moderate in the upper part of the Betts soil and moderately slow in the underlying material. It is rapid in the Talmo soil. Available water capacity is high in the Betts soil and low in the Talmo soil. Runoff is rapid on the Betts soil and slow on the Talmo soil. The shrink-swell potential is moderate in the Betts soil and low in the Talmo soil.

Although most of the acreage supports native grasses, these soils are poorly suited to range. The native vegetation on the Betts soil dominantly is little bluestem, sideoats grama, needleandthread, and prairie dropseed. That on the Talmo soil dominantly is blue grama, needleandthread, and sideoats grama. Overused areas are dominated by Kentucky bluegrass, blue grama, threadleaf sedge, and unpalatable forbs.

These soils generally are too steep and too shallow over the underlying material for cultivated crops, tame pasture and hay, and windbreaks and environmental plantings. They are too steep for building site development and sanitary facilities. The Talmo soil is a probable source of sand and gravel, which can be used as road construction material.

The Betts soil is in capability unit VIIe-1, Thin Upland range site; the Talmo soil is in capability unit VIs-3, Very Shallow range site.

BkA—Blendon fine sandy loam, 0 to 2 percent slopes. This deep, well drained, nearly level soil is on terraces. Areas are 10 to 100 acres in size and irregular in shape. Slopes are short and complex.

Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is dark grayish brown and brown, very friable fine sandy loam about 28 inches thick. The underlying material to a depth of 60 inches is pale brown and very pale brown fine sandy loam and loamy sand. It is calcareous in the lower part. In some areas the soil is dark to a depth of less than 20 inches. In other areas it is subject to rare flooding.

Included with this soil in mapping are small areas of Davis, Dempster, and Enet soils. These soils make up less than 15 percent of any one mapped area. They contain more clay in the subsoil than the Blendon soil. Dempster and Enet soils are underlain by gravelly material below a depth of 20 inches. They are in positions on the landscape similar to those of the Blendon soil. Davis soils are in swales.

The content of organic matter is moderate and fertility medium in the Blendon soil. Permeability is moderate or moderately rapid in the upper part of the profile and moderately rapid or rapid in the lower part. Available water capacity is moderate. Runoff is slow.

Most of the acreage is cropland. This soil is well suited to cultivated crops. Controlling wind erosion and conserving moisture are the main concerns of management. Improving fertility and increasing the content of organic matter are other management concerns. Minimizing tillage, leaving crop residue on the surface, and including close-grown crops in the cropping system help to control wind erosion and conserve moisture. Stripcropping and field windbreaks also help to control wind erosion. Applying animal manure and including grasses and legumes in the cropping system improve fertility and increase the content of organic matter.

This soil is well suited to tame pasture and hay. Seeding suitable tame pasture plants, such as alfalfa, intermediate wheatgrass, and smooth bromegrass, is an effective means of controlling wind erosion and conserving moisture.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well. Keeping crop residue on the surface during site preparation helps to control wind erosion.

This soil is well suited to range. The native vegetation dominantly is little bluestem, big bluestem, prairie sandreed, and needlegrass. Overused areas are dominated by Kentucky bluegrass and blue grama.

This soil is well suited to most kinds of building site development, but the sides of shallow excavations tend to cave in unless they are shored. The soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the pollution of ground water.

The capability unit is IIs-3; Sandy range site.

BmB—Blendon-Henkin fine sandy loams, 2 to 6 percent slopes. These deep, well drained, undulating soils are on terraces. The Blendon soil is on the concave, middle and lower side slopes and in swales. The Henkin soil is on the upper side slopes and ridges. Slopes are short and complex. Areas are 10 to 75 acres in size and are irregular in shape. They are 60 to 70 percent Blendon soil and 25 to 35 percent Henkin soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Blendon soil is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is dark grayish brown and brown, very friable fine sandy loam about 28 inches thick. The underlying material to a depth of 60 inches is pale brown and very pale brown fine sandy loam and loamy sand. It is calcareous in the lower part.

Typically, the surface layer of the Henkin soil is very dark grayish brown fine sandy loam about 7 inches thick. The subsoil is very friable fine sandy loam about 23 inches thick. The upper part is dark grayish brown, the next part is grayish brown, and the lower part is light brownish gray and calcareous. The underlying material to a depth of 60 inches is light gray, calcareous fine sandy loam and loamy sand. In places gravelly material is below a depth of 40 inches.

Included with these soils in mapping are small areas of Davis, Dempster, and Enet soils. These included soils make up less than 10 percent of any one mapped area. They contain more clay in the subsoil than the Blendon and Henkin soils. Dempster and Enet soils are underlain by gravelly material at a depth of 20 to 40 inches. They are in positions on the landscape similar to those of the Blendon and Henkin soils. Davis soils are in swales.

The content of organic matter is moderate and fertility medium in the Blendon and Henkin soils. Permeability is moderate or moderately rapid in the upper part of the profile and moderately rapid or rapid in the lower part. Available water capacity is moderate. Runoff is slow.

Most of the acreage is cropland. These soils are fairly well suited to cultivated crops. Controlling wind erosion and conserving moisture are the main concerns of management. Improving fertility and increasing the content of organic matter are other management concerns. Minimizing tillage, leaving crop residue on the surface, and including close-grown crops in the cropping system help to control wind erosion and conserve moisture. Stripcropping and field windbreaks also help to control wind erosion. Applying animal manure and including grasses and legumes in the cropping system improve fertility and increase the content of organic matter.

These soils are well suited to tame pasture and hay. Seeding suitable tame pasture plants, such as alfalfa, intermediate wheatgrass, and smooth bromegrass, is an effective means of controlling wind erosion and conserving moisture.

These soils are well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well. Keeping crop residue on the surface during site preparation helps to control wind erosion.

These soils are well suited to range. The native vegetation dominantly is little bluestem, prairie sandreed, big bluestem, and needlegrass. Overused areas are dominated by Kentucky bluegrass and blue grama.

These soils are well suited to most kinds of building site development, but the sides of shallow excavations tend to cave in unless they are shored. The soils readily absorb but do not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the pollution of ground water.

The capability unit is IIIe-7; Sandy range site.

Ca—Chancellor silty clay loam. This deep, somewhat poorly drained, nearly level soil is in swales in the uplands. It receives runoff from adjacent soils and is frequently flooded after heavy rainfall or rapid snowmelt. Areas are 5 to more than 200 acres in size and are long and narrow.

Typically, the surface layer is very dark gray silty clay loam about 18 inches thick. The subsoil is about 26 inches thick. The upper part is dark gray, firm silty clay; the next part is light brownish gray, mottled, firm silty clay; and the lower part is light yellowish brown, mottled, friable silty clay loam that has accumulations of gypsum. The underlying material to a depth of 60 inches is light gray, mottled, calcareous silty clay loam.

Included with this soil in mapping are small areas of Tetonka, Trent, Wakonda, Wentworth, and Worthing soils. These soils make up less than 15 percent of any one mapped area. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions. The moderately well drained Trent soils contain less clay in the subsoil than the Chancellor soil. They are in positions on the landscape similar to those of the Chancellor soil. Wakonda soils have a high content of lime within a depth of 16 inches. They are on slight rises above the Chancellor soil. Wentworth soils do not have dark colors below a depth of 20 inches. They are higher on the landscape than the Chancellor soil.

The content of organic matter and fertility are high in the Chancellor soil. Tilth is fair. Permeability is slow. Available water capacity is high. A seasonal high water table is within a depth of 3 feet in the spring of most years. Runoff is very slow. The shrink-swell potential is high.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Examples of suitable pasture plants are alfalfa, Garrison creeping foxtail, intermediate wheatgrass, reed canarygrass, and smooth bromegrass. Planting and harvesting are delayed in some years because of the wetness and the flooding. The soil becomes compacted if cultivated when wet. Increasing the rate of water intake and improving tilth are management concerns. Installing a drainage system helps to control the wetness. Leaving crop residue on the surface, applying animal manure, including grasses and legumes in the cropping system, and deferring tillage when the soil is wet increase the water intake rate and improve the tilth.

This soil is well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs can grow well, especially those that require an abundant moisture supply.

This soil generally is unsuitable as a site for buildings and most sanitary facilities because of the flooding and the wetness.

The capability unit is IIw-1; Overflow range site.

Cc—Chaska loam, channeled. This deep, somewhat poorly drained, nearly level soil is on flood plains generally dissected by meandering channels (fig. 6). It is frequently flooded after heavy rainfall or rapid snowmelt. Areas are 10 to more than 1,000 acres in size. They are long and narrow and include the stream channel.

Typically, the surface layer is dark gray loam about 9 inches thick. The underlying material to a depth of 60 inches is dark gray and gray, mottled, stratified silt loam and loam. The soil is calcareous throughout. In some areas the content of silt or sand is higher.

Included with this soil in mapping are small areas of the well drained Betts, Davis, Ethan, and Roxbury soils. These soils make up less than 15 percent of any one mapped area. Betts and Ethan soils do not have dark colors below a depth of 20 inches. They are on uplands. Davis and Roxbury soils are higher on the flood plains than the Chaska soil.

The content of organic matter and fertility are high in the Chaska soil. Permeability is moderate. Available water capacity is high. A seasonal high water table is at a depth of 1 to 3 feet in the spring of most years. Runoff is slow.

Most of the acreage supports native grasses. This soil is well suited to range. It regularly benefits from the moisture received as stream overflow. The native vegetation dominantly is big bluestem, indiangrass, and switchgrass. Clumps of native trees and shrubs are along some of the channels. Overused areas are dominated by Kentucky bluegrass and less palatable species.

This soil is well suited to tame pasture, but the fields generally are dissected into small tracts by the meandering streams. Garrison creeping foxtail, intermediate wheatgrass, reed canarygrass, and smooth bromegrass grow well.

Because of the small size of each tract and the flooding, this soil generally is unsuited to cultivated crops. It is suited to windbreaks and environmental plantings. All climatically suited trees and shrubs grow well. Because of the meandering stream channels,

Figure 6.—A meandering stream in an area of Chaksa loam, channeled.

planting trees and shrubs by machine is difficult in many areas.

This soil generally is unsuitable as a site for buildings and sanitary facilities because of the flooding.

The capability unit is Vlw-1; Subirrigated range site.

Cd—Clamo silty clay. This deep, poorly drained, level soil is on flood plains. It is occasionally flooded for long periods after heavy rainfall or rapid snowmelt. Areas are 5 to more than 1,000 acres in size and are irregular in shape.

Typically, the surface layer is very dark gray silty clay about 12 inches thick. The subsoil is about 27 inches of dark gray, firm silty clay and silty clay loam. It is calcareous in the lower part. The underlying material to a depth of 60 inches is gray and light olive gray, mottled, calcareous silty clay loam. In some areas the subsoil contains less clay.

Included with this soil in mapping are small areas of Chaska and Roxbury Variant soils. These soils make up less than 10 percent of any one mapped area. The somewhat poorly drained Chaska soils are in drainageways. The moderately well drained Roxbury Variant soils contain less clay in the upper part than the Clamo soil. Also, they are slightly higher on the landscape.

The content of organic matter and fertility are high in the Clamo soil. Tilth is poor. Permeability is slow. Available water capacity is high. A seasonal high water table is within a depth of 3 feet in the spring of most years. Runoff is very slow. The shrink-swell potential is high.

Most of the acreage is cropland. This soil is well suited to cultivated crops. In wet years late planted crops are better suited than small grain because the wetness delays planting in the spring. The soil dries slowly after rains because it is slowly permeable. It becomes compacted if cultivated when wet. Increasing the water intake rate and improving tilth are concerns of management. Open drainage ditches help to remove excess water in some areas, but suitable outlets generally are not available. Leaving crop residue on the surface, applying animal manure, including grasses and legumes in the cropping system, and deferring tillage when the soil is wet increase the water intake rate and improve the tilth.

This soil is well suited to tame pasture and hay. Alfalfa, Garrison creeping foxtail, intermediate wheatgrass, reed canarygrass, and smooth bromegrass grow well.

This soil is well suited to windbreaks and environmental plantings. Most climatically suited trees

and shrubs grow well, especially those that require an abundant moisture supply.

This soil generally is unsuitable as a site for buildings and sanitary facilities because of the flooding and the wetness.

The capability unit is IIw-3; Overflow range site.

Ce—Clamo clay, gravelly substratum. This deep, poorly drained, level soil is on flood plains. It is occasionally flooded for long periods after heavy rainfall or rapid snowmelt. Sand and gravel are at a depth of 40 to 60 inches. Areas are 10 to more than 1,000 acres in size and are irregular in shape.

Typically, the surface layer is very dark gray clay about 11 inches thick. The subsoil is very dark gray and dark gray, firm clay about 25 inches thick. It is mottled and calcareous in the lower part. The upper 15 inches of the underlying material is dark grayish brown and light gray, mottled, calcareous sandy clay loam. The lower part to a depth of 60 inches is light olive gray, calcareous gravelly loamy sand. In places the soil is calcareous throughout.

Included with this soil in mapping are small areas of Arlo and Dimo soils. These soils make up less than 15 percent of any one mapped area. They are in positions on the landscape similar to those of the Clamo soil. They are underlain by gravelly material at a depth of 20 to 40 inches. Arlo soils have a high content of lime within a depth of 16 inches. The somewhat poorly drained Dimo soils contain less clay in the surface layer and subsoil than the Clamo soil.

The content of organic matter and fertility are high in the Clamo soil. Tilth is poor. Permeability is slow in the upper part of the profile and rapid in the underlying material. Available water capacity is moderate. A seasonal high water table is within a depth of 3 feet in the spring of most years. Runoff is very slow. The shrink-swell potential is high in the upper part of the profile and low in the lower part of the underlying material.

Most of the acreage is cropland. This soil is well suited to cultivated crops. In wet years late planted crops are better suited than small grain because the wetness delays planting in the spring. The soil becomes compacted if cultivated when wet. Increasing the water intake rate and improving tilth are concerns of management. Open drainage ditches help to remove excess water in some areas, but suitable outlets generally are not available. Leaving crop residue on the surface, applying animal manure, including grasses and legumes in the cropping system, and deferring tillage when the soil is wet increase the water intake rate and improve the tilth.

This soil is well suited to tame pasture and hay. Alfalfa, Garrison creeping foxtail, intermediate wheatgrass, reed canarygrass, and smooth bromegrass grow well.

This soil is well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs grow well, especially those that require an abundant moisture supply.

This soil generally is unsuitable as a site for buildings and sanitary facilities because of the flooding and the wetness.

The capability unit is IIw-3; Overflow range site.

ChA—Clarno-Bonilla loams, 0 to 2 percent slopes. These deep, nearly level soils are on uplands. The well drained Clarno soil is on slight rises. The moderately well drained Bonilla soil is in swales. It is frequently flooded for very brief periods after heavy rainfall or rapid snowmelt. Areas are 10 to more than 1,000 acres in size and are irregular in shape. They are about 60 to 70 percent Clarno soil and 20 to 30 percent Bonilla soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Clarno soil is very dark gray loam about 8 inches thick. The subsoil is friable clay loam about 21 inches thick. It is dark grayish brown in the upper part, grayish brown in the next part, and light brownish gray and calcareous in the lower part. The underlying material to a depth of 60 inches is light gray and pale yellow, calcareous clay loam.

Typically, the surface layer of the Bonilla soil is very dark gray loam about 12 inches thick. The subsoil is friable clay loam about 24 inches thick. It is dark gray in the upper part, grayish brown in the next part, and light gray and calcareous in the lower part. The underlying material to a depth of 60 inches is light gray and pale yellow, mottled, calcareous clay loam. In some areas the surface layer and subsoil contain more silt.

Included with these soils in mapping are small areas of Crossplain, Davison, and Tetonka soils. These included soils make up less than 15 percent of any one mapped area. The somewhat poorly drained Crossplain soils are in swales and shallow drainageways. Davison soils have a high content of lime within a depth of 16 inches. They are on slight rises above the swales and depressions. The poorly drained Tetonka soils are in depressions.

The content of organic matter is moderate in the Clarno soil and high in the Bonilla soil. Fertility is medium in the Clarno soil and high in the Bonilla soil. Permeability is moderate in the upper part of both soils and moderately slow in the underlying material. Available water capacity is high. In the Bonilla soil a seasonal high water table is at a depth of 3 to 6 feet in the spring of most years. Runoff is slow on both soils. The shrink-swell potential is moderate.

Most of the acreage is cropland. These soils are well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants. The soils have few limitations, but planting may be delayed in areas of the Bonilla soil because of the wetness. Minimizing tillage and leaving crop residue on the surface conserve moisture and improve fertility and tilth.

These soils are well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs grow well. Those that require an abundant moisture supply grow especially well on the Bonilla soil.

Because the Bonilla soil is subject to flooding, the Clarno soil is better suited to building site development and septic tank absorption fields. The moderate shrink-swell potential, however, is a limitation on building sites and the restricted permeability a limitation in septic tank absorption fields. Backfilling with sandy material, providing foundation drains, and diverting runoff away from buildings help to prevent the structural damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. Enlarging the absorption area of the septic tank absorption fields helps to overcome the slow absorption of liquid waste.

The capability unit is I-2; the Clarno soil is in Silty range site and the Bonilla soil in Overflow range site.

ChB—Clarno-Bonilla loams, 1 to 6 percent slopes. These deep, nearly level and undulating soils are on uplands dissected in some areas by well defined drainageways. The well drained Clarno soil is on convex slopes. In some areas a few scattered stones are on the surface. The moderately well drained Bonilla soil is in swales. It is frequently flooded for very brief periods after heavy rainfall or rapid snowmelt. Slopes generally are short and complex, but some are long and smooth. Areas are 10 to more than 1,000 acres in size and are irregular in shape. They are 60 to 70 percent Clarno soil and 15 to 25 percent Bonilla soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Clarno soil is very dark grayish brown loam about 8 inches thick. The subsoil is friable clay loam about 19 inches thick. It is dark grayish brown in the upper part, grayish brown in the next part, and light brownish gray and calcareous in the lower part. The underlying material to a depth of 60 inches is light yellowish brown and pale yellow, mottled, calcareous clay loam.

Typically, the surface layer of the Bonilla soil is very dark gray loam about 13 inches thick. The subsoil is friable clay loam about 29 inches thick. It is dark gray in the upper part, grayish brown and mottled in the next part, and light brownish gray, mottled, and calcareous in the lower part. The underlying material to a depth of 60 inches is light brownish gray, light yellowish brown, and light gray, mottled, calcareous clay loam. In some areas the surface layer and subsoil contain more silt.

Included with these soils in mapping are small areas of Crossplain, Ethan, and Tetonka soils. These included soils make up less than 15 percent of any one mapped area. The somewhat poorly drained Crossplain soils are in shallow drainageways. Ethan soils have free carbonates within a depth of 9 inches. The poorly drained Tetonka soils are in depressions.

The content of organic matter is moderate in the Clarno soil and high in the Bonilla soil. Fertility is medium in the Clarno soil and high in the Bonilla soil. Permeability is moderate in the upper part of both soils and moderately slow in the underlying material. Available water capacity is high. In the Bonilla soil a seasonal high water table is at a depth of 3 to 6 feet in the spring of most years. Runoff is medium on the Clarno soil and slow on the Bonilla soil. The shrink-swell potential is moderate in both soils.

Most of the acreage is cropland. These soils are well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants. Controlling erosion is the main management concern on the Clarno soil. Conserving moisture and improving fertility are other management concerns. Planting may be delayed in some years because of the wetness in the Bonilla soil, but in most years the additional moisture is beneficial. Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to control erosion, conserve moisture, and improve fertility. Contour farming, grassed waterways, and terraces also help to control erosion.

These soils are well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs grow well. Those that require an abundant moisture supply grow especially well on the Bonilla soil. Planting on the contour helps to control erosion and conserves moisture.

Because the Bonilla soil is subject to flooding, the Clarno soil is better suited to building site development. The moderate shrink-swell potential, however, is a limitation. Backfilling with sandy material, providing foundation drains, and diverting runoff away from buildings help to prevent the structural damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage.

The Clarno soil is only fairly well suited to septic tank absorption fields because of the restricted permeability. Enlarging the absorption area, however, helps to overcome the slow absorption of liquid waste. The Bonilla soil is generally unsuitable as a septic tank absorption field because of the flooding.

The Clarno soil is in capability unit IIe-2, Silty range site; the Bonilla soil is in capability unit I-1, Overflow range site.

CkA—Clarno-Crossplain-Davison complex, 0 to 3 percent slopes. These deep, nearly level and gently undulating soils are on uplands. The moderately well drained Clarno and Davison soils are on rises. The somewhat poorly drained Crossplain soil is in swales and shallow drainageways (fig. 7). It is frequently flooded for brief periods after heavy rainfall or rapid snowmelt. Areas

are 10 to several thousand acres in size and are irregular in shape. They are 50 to 70 percent Clarno soil, 15 to 30 percent Crossplain soil, and 5 to 20 percent Davison soil. The three soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Clarno soil is very dark gray loam about 9 inches thick. The subsoil is friable clay loam about 21 inches thick. It is dark grayish brown in the upper part, grayish brown in the next part, and light brownish gray and calcareous in the lower part. The underlying material to a depth of 60 inches is light brownish gray, light gray, and light yellowish brown, mottled, calcareous clay loam.

Typically, the surface layer of the Crossplain soil is dark gray clay loam about 9 inches thick. The subsoil is about 29 inches thick. It is dark gray, firm clay in the upper part; gray, mottled, firm clay in the next part; and light brownish gray, mottled, friable, calcareous clay loam in the lower part. The underlying material to a depth of 60 inches is light brownish gray and light yellowish brown, mottled, calcareous clay loam. It has accumulations of gypsum in the upper part.

Typically, the surface layer of the Davison soil is dark grayish brown loam about 10 inches thick. The next 4 inches is grayish brown, friable clay loam. The underlying material to a depth of 60 inches is light yellowish brown clay loam. It is mottled and has accumulations of gypsum in the lower part. The soil is calcareous throughout.

Included with these soils in mapping are small areas of Bonilla, Tetonka, and Worthing soils. These included soils make up less than 10 percent of any one mapped area. The moderately well drained Bonilla soils are dark to a depth of more than 20 inches. They are in swales. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions.

The content of organic matter is moderate in the Clarno and Davison soils and high in the Crossplain soil. Fertility is medium in the Clarno soil, high in the Crossplain soil, and low in the Davison soil. Tilth is fair in the Crossplain soil. Permeability is moderate in the upper part of the Clarno and Davison soils and moderately slow in the underlying material. It is slow in the Crossplain soil. Available water capacity is high in all of the soils. In the spring of most years, a seasonal high water table is at a depth of 3 to 6 feet in the Clarno soil, within a depth of 3 feet in the Crossplain soil, and at a depth of 1.5 to 4 feet in the Davison soil. Runoff is slow on all three soils. The shrink-swell potential is moderate in the Clarno and Davison soils and high in the Crossplain soil.

Most of the acreage is cropland. These soils are well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants. The Clarno soil has few limitations. Planting may be delayed in some years because of the wetness in the Crossplain and Davison soils. The Crossplain soil becomes compacted if cultivated when wet. The high content of lime in the surface layer of the Davison soil adversely affects the availability of plant nutrients. Controlling wetness and improving tilth in areas of the Crossplain soil are the

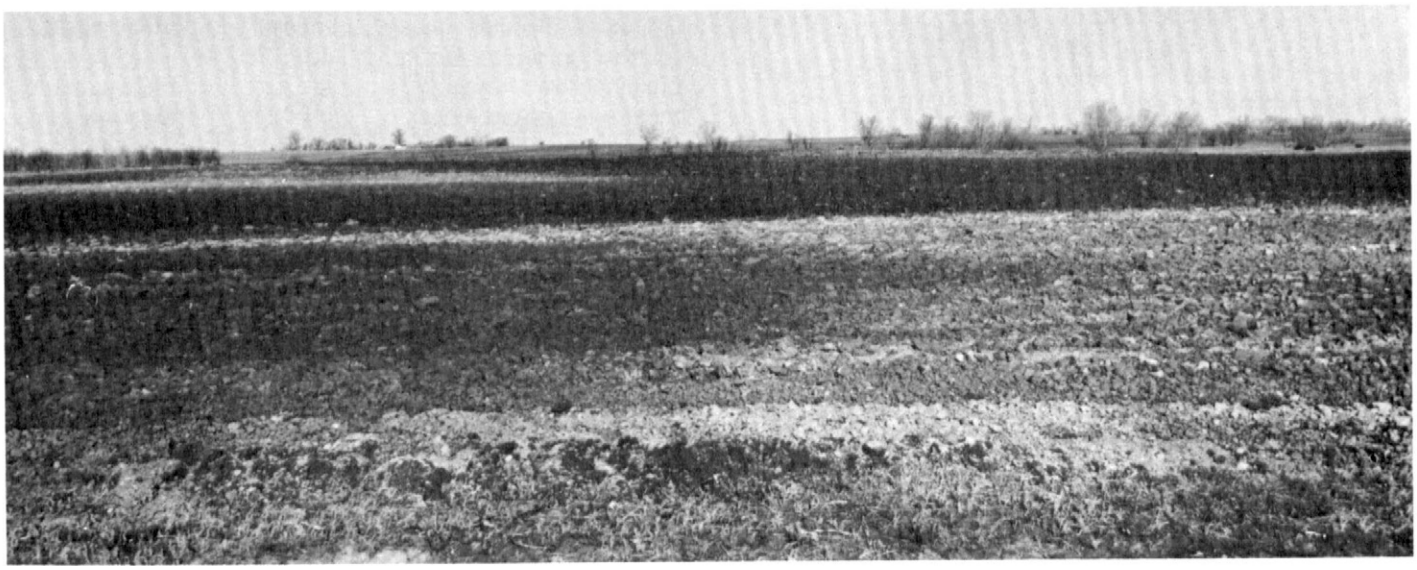

Figure 7.—An area of Clarno-Crossplain-Davison complex, 0 to 3 percent slopes. The Davison soil is in an intermediate position on the landscape between the Clarno soil on slight rises and the Crossplain soil in swales.

main management concerns. Conserving moisture and improving fertility are other management concerns. A surface drainage system helps to control the wetness in the Crossplain soil. Minimizing tillage, leaving crop residue on the surface, applying animal manure, and including grasses and legumes in the cropping system conserve moisture and improve fertility and tilth.

These soils are well suited to windbreaks and enviornmental plantings. Most climatically suited trees and shrubs grow well. Those that require an abundant moisture supply grow especially well on the Crossplain soil.

The Clarno soil is poorly suited and the Crossplain and Davison soils generally unsuited to most kinds of building site development. The wetness is the main limitation. Also, flooding is a hazard on the Crossplain soil and the moderate shrink-swell potential a limitation in the Clarno soil. Backfilling with gravelly material, reinforcing foundations and footings, diverting runoff away from buildings, and installing a subsurface drainage system help to prevent the structural damage caused by the shrinking and swelling and temporary wetness of the Clarno soil. Foundation drains also reduce the wetness.

These soils generally are unsuitable as sites for septic tank absorption fields because of the wetness.

The Clarno soil is in capability unit I-2, Silty range site; the Crossplain soil is in capability unit IIw-1, Overflow range site; and the Davison soil is in capability unit IIe-4, Limy Subirrigated range site.

CmB—Clarno-Davison loams, 2 to 5 percent slopes. These deep, undulating soils are on uplands. The well drained Clarno soil is on convex slopes. In some areas scattered stones are on the surface. The moderately well drained Davison soil generally is in the less sloping areas. Slopes generally are short and complex. Areas are 5 to 100 acres in size and are irregular in shape. They are 55 to 70 percent Clarno soil and 20 to 35 percent Davison soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Clarno soil is very dark gray loam about 8 inches thick. The subsoil is friable clay loam about 21 inches thick. It is very dark grayish brown in the upper part, olive gray in the next part, and light olive gray and calcareous in the lower part. The underlying material to a depth of 60 inches is pale olive, mottled, calcareous clay loam. It has accumulations of gypsum in the lower part.

Typically, the surface layer of the Davison soil is dark grayish brown, calcareous loam about 10 inches thick. The next 4 inches is grayish brown, friable, calcareous clay loam. The underlying material to a depth of 60 inches is light yellowish brown, calcareous clay loam. It is mottled and has accumulations of gypsum in the lower part.

Included with these soils in mapping are small areas of Bonilla, Crossplain, Tetonka, and Worthing soils. These included soils make up less than 15 percent of any one mapped area. The moderately well drained Bonilla soils are dark to a depth of more than 20 inches. They are in swales. The somewhat poorly drained Crossplain soils are in shallow drainageways. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions.

The content of organic matter is moderate in the Clarno and Davison soils. Fertility is medium in the Clarno soil and low in the Davison soil. Permeability is moderate in the subsoil of both soils and moderately slow in the underlying material. Available water capacity is high. In the Davison soil a seasonal high water table is at a depth of 1.5 to 4 feet in the spring of most years. Runoff is medium on both soils. The shrink-swell potential is moderate.

Most of the acreage is cropland. These soils are well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants. The high content of lime in the surface layer of the Davison soil adversely affects the availability of plant nutrients. Controlling erosion and conserving moisture are the main management concerns. Improving fertility in the Davison soil also is a concern. Minimizing tillage, leaving crop residue on the surface, applying animal manure, and including grasses and legumes in the cropping system help to control erosion, conserve moisture, and improve fertility.

These soils are well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs grow well.

The Clarno soil is only fairly well suited to most kinds of building site development because of the moderate shrink-swell potential. The Davison soil is generally unsuited to most kinds of building site development because of the wetness. Backfilling with gravelly material, providing foundation drains, and diverting runoff away from buildings help to prevent the structural damage caused by the shrinking and swelling of the Clarno soil. Reinforcing foundations and footings also helps to prevent this damage.

The Clarno soil is only fairly well suited to septic tank absorption fields because of the restricted permeability. Enlarging the absorption area, however, helps to overcome the slow absorption of liquid waste. The Davison soil generally is unsuitable as a site for septic tank absorption fields because of the wetness.

The capability unit is IIe-2; the Clarno soil is in Silty range site and the Davison soil in Limy Subirrigated range site.

CoB—Clarno-Ethan loams, 2 to 6 percent slopes. These deep, well drained, undulating soils are on uplands that are dissected by well defined drainageways

in some areas. The Clarno soil is on smooth side slopes. The Ethan soil is on the upper slopes and knolls. A few scattered stones are on the surface in some areas. Slopes generally are short and complex. Areas are 5 to several thousand acres in size and are irregular in shape. They are 50 to 75 percent Clarno soil and 15 to 40 percent Ethan soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Clarno soil is very dark gray loam about 8 inches thick. The subsoil is friable clay loam about 19 inches thick. It is very dark grayish brown in the upper part, grayish brown in the next part, and light gray and calcareous in the lower part. The underlying material to a depth of 60 inches is light gray and pale yellow, mottled, calcareous clay loam.

Typically, the surface layer of the Ethan soil is dark grayish brown loam about 8 inches thick. The next 13 inches is light brownish gray, friable clay loam. The underlying material to a depth of 60 inches is light gray and pale yellow, mottled clay loam. The soil is calcareous throughout. In some areas the surface layer is less than 6 inches thick.

Included with these soils in mapping are small areas of Bonilla, Crossplain, Delmont, Tetonka, and Worthing soils. These included soils make up less than 15 percent of any one mapped area. The moderately well drained Bonilla soils are in swales. The somewhat poorly drained Crossplain soils are in shallow drainageways. The somewhat excessively drained Delmont soils are underlain by gravelly material at a depth of 14 to 20 inches. They are in positions on the landscape similar to those of the Ethan soil. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions.

The content of organic matter is moderate in the Clarno soil and low in the Ethan soil. Fertility is medium in the Clarno soil and low in the Ethan soil. Permeability is moderate in the subsoil of both soils and moderately slow in the underlying material. Available water capacity is high. Runoff is medium. The shrink-swell potential is moderate.

Most of the acreage is cropland. The Clarno soil is well suited and the Ethan soil fairly well suited to cultivated crops. The high content of lime in the surface layer of the Ethan soil adversely affects the availability of plant nutrients. Controlling erosion is the main management concern. Conserving moisture and improving fertility are other management concerns. Minimizing tillage, leaving crop residue on the surface, applying animal manure, and including grasses and legumes in the cropping system help to control erosion, conserve moisture, and improve fertility. Contour farming, grassed waterways, and terraces also help to control erosion, but the slopes in some areas are too short or too irregular for contouring and terracing.

A cover of tame pasture plants or hay is effective in controlling erosion. These soils are well suited to tame pasture and hay, but forage production is limited by the high content of lime in the Ethan soil. Alfalfa, intermediate wheatgrass, and smooth bromegrass are the best suited species.

These soils are suited to windbreaks and environmental plantings. Except for those that require an abundant supply of moisture, all climatically suited trees and shrubs grow well on the Clarno soil. No trees or shrubs grow well on the Ethan soil; optimum survival and vigor are unlikely. Planting on the contour helps to control erosion.

Because of the moderate shrink-swell potential, these soils are only fairly well suited to most kinds of building site development. Backfilling with gravelly material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structural damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage.

Because of the restricted permeability, these soils are only fairly well suited to septic tank absorption fields. Enlarging the absorption area, however, helps to overcome the slow absorption of liquid waste.

The Clarno soil is in capability unit IIe-2, and the Ethan soil is in capability unit IIIe-6; both soils are in Silty range site.

CoC—Clarno-Ethan loams, 5 to 9 percent slopes. These deep, well drained, undulating and gently rolling soils are on uplands. The Clarno soil is on the longer, smoother side slopes. The Ethan soil is on the upper slopes and ridgetops. In some areas a few scattered stones are on the surface. Areas are 10 to more than 200 acres in size and are irregular in shape. They are 40 to 50 percent Clarno soil and 40 to 50 percent Ethan soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Clarno soil is very dark grayish brown loam about 8 inches thick. The subsoil is friable clay loam about 16 inches thick. The upper part is grayish brown, and the lower part is light gray and calcareous. The underlying material to a depth of 60 inches is light gray and pale yellow, mottled, calcareous clay loam.

Typically, the surface layer of the Ethan soil is dark grayish brown, calcareous loam about 8 inches thick. The next 13 inches is light brownish gray, friable, calcareous clay loam. The underlying material to a depth of 60 inches is light gray and pale yellow, mottled, calcareous clay loam. In places the surface layer is less than 6 inches thick.

Included with these soils in mapping are small areas of Bonilla, Crossplain, Delmont, Tetonka, and Worthing soils. These included soils make up 15 to 20 percent of any one mapped area. The moderately well drained Bonilla soils are in swales. The somewhat poorly drained

Crossplain soils are in shallow drainageways. The somewhat excessively drained Delmont soils are underlain by gravelly material at a depth of 14 to 20 inches. They are in positions on the landscape similar to those of the Ethan soil. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions.

The content of organic matter is moderate in the Clarno soil and low in the Ethan soil. Fertility is medium in the Clarno soil and low in the Ethan soil. Permeability is moderate in the subsoil of both soils and moderately slow in the underlying material. Available water capacity is high. Runoff is medium. The shrink-swell potential is moderate.

Most of the acreage is cropland. These soils are fairly well suited to cultivated crops. Controlling erosion and conserving moisture are the main concerns of management. Improving the fertility of the Ethan soil also is a concern. The high content of lime in the surface layer of this soil adversely affects the availability of plant nutrients. Minimizing tillage and leaving crop residue on the surface help to control erosion, conserve moisture, and improve fertility. Contour farming, grassed waterways, and terraces also help to control erosion, but the slopes in some areas are too short or too irregular for contouring and terracing.

A cover of tame pasture plants or hay is effective in controlling erosion. These soils are well suited to tame pasture and hay, but forage production is limited by the high content of lime in the Ethan soil. Alfalfa, intermediate wheatgrass, and smooth bromegrass are the best suited species.

These soils are well suited to range. The native vegetation dominantly is little bluestem, big bluestem, and needlegrass. Overused areas are dominated by western wheatgrass, blue grama, and Kentucky bluegrass.

These soils are well suited to windbreaks and environmental plantings. Except for those that require an abundant supply of moisture, all climatically suited trees and shrubs grow well on the Clarno soil. No trees or shrubs grow well on the Ethan soil; optimum survival and vigor are unlikely. Planting on the contour helps to control erosion.

Because of the moderate shrink-swell potential, these soils are only fairly well suited to most kinds of building site development. Backfilling with sandy material, providing foundation drains, and diverting runoff away from the buildings, however, help to prevent the structural damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. Land shaping is needed in some areas.

Because of the restricted permeability, these soils are only fairly well suited to septic tank absorption fields. Enlarging the absorption area, however, helps to overcome the slow absorption of liquid waste. Land shaping and installing the distribution lines across the slope generally improve the efficiency of the absorption field.

The Clarno soil is in capability unit IIIe-1, and the Ethan soil is in capability unit IVe-2; both soils are in Silty range site.

Cr—Crossplain clay loam. This deep, somewhat poorly drained, nearly level soil is in swales and shallow drainageways on uplands. It is frequently flooded for brief periods after heavy rainfall or rapid snowmelt. Areas are 5 to 60 acres in size and are long and narrow.

Typically, the surface soil is very dark gray clay loam about 16 inches thick. The subsoil is very dark gray and gray, firm clay about 27 inches thick. It is mottled in the lower part. The underlying material to a depth of 60 inches is light gray, mottled, calcareous clay loam. In some areas the surface layer and the subsoil contain less sand.

Included with this soil in mapping are small areas of Bonilla, Davison, Tetonka, and Worthing soils. These soils make up less than 15 percent of any one mapped area. The moderately well drained Bonilla soils are in positions on the landscape similar to those of the Crossplain soil. Their subsoil contains less clay than that of the Crossplain soil. Davison soils have a high content of lime within 16 inches of the surface. They are on slight rises above the Crossplain soil. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions.

The content of organic matter and fertility are high in the Crossplain soil. Tilth is fair. Permeability is slow. Available water capacity is high. A seasonal high water table is within a depth of 3 feet in the spring of most years. Runoff is very slow. The shrink-swell potential is high.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Examples of suitable pasture plants are alfalfa, Garrison creeping foxtail, intermediate wheatgrass, reed canarygrass, and smooth bromegrass. Planting and harvesting are delayed in some years because of the wetness and the flooding. The soil becomes compacted if cultivated when wet. Increasing the rate of water intake and improving tilth are management concerns. Installing a drainage system helps to control the wetness. Leaving crop residue on the surface, applying animal manure, including grasses and legumes in the cropping system, and deferring tillage when the soil is wet increase the water intake rate and improve the tilth.

This soil is well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs can grow well, especially those that require an abundant supply of moisture.

This soil generally is unsuitable as a site for buildings and most sanitary facilities because of the flooding and the wetness.

The capability unit is IIw-1; Overflow range site.

DaA—Davis loam, 0 to 2 percent slopes. This deep, well drained, nearly level soil is on flood plains, alluvial fans, and terraces. It is occasionally flooded for brief periods after heavy rainfall or rapid snowmelt. Areas are 5 to 150 acres in size and are irregular in shape.

Typically, the surface layer is very dark gray loam about 9 inches thick. The subsurface layer is very dark gray silt loam about 5 inches thick. The subsoil is about 34 inches of very dark gray and dark gray, friable silt loam. It is calcareous in the lower part. The underlying material to a depth of 60 inches is grayish brown, calcareous silt loam. In places the soil is calcareous within a depth of 20 inches. In other places the surface layer and subsoil contain more silt. In some areas gravelly material is below a depth of 30 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Chaska and Lamo soils. These soils make up less than 10 percent of any one mapped area. They are on flood plains.

The content of organic matter and fertility are high in the Davis soil. Permeability is moderate. Available water capacity is high. Runoff is slow. The shrink-swell potential is moderate.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. It has few limitations. Alfalfa, Garrison creeping foxtail, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants. In some years fieldwork is delayed because of runoff from adjacent soils, but in most years the additional moisture is beneficial. Conserving moisture during dry periods is the main concern of management. Leaving crop residue on the surface and including grasses and legumes in the cropping system increase the content of organic matter and conserve moisture.

This soil is well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs grow well, especially those that require an abundant moisture supply.

This soil generally is unsuitable as a site for buildings and most sanitary facilities because of the flooding.

The capability unit is I-1; Overflow range site.

DaB—Davis loam, 2 to 6 percent slopes. This deep, well drained, gently sloping soil is on foot slopes and alluvial fans. Areas are 5 to 75 acres in size and are irregular in shape. Slopes generally are short and smooth.

Typically, the surface layer is very dark gray loam about 9 inches thick. The subsurface layer is very dark gray silt loam about 5 inches thick. The subsoil is about 34 inches of very dark gray and dark gray, friable silt loam and loam. It is calcareous in the lower part. The underlying material to a depth of 60 inches is grayish brown, calcareous silt loam. In some places the soil is calcareous within a depth of 20 inches. In other places the surface layer and subsoil contain more silt. In some areas the soil is dark to a depth of less than 20 inches. In other areas sand and gravel are below a depth of 40 inches.

Included with this soil in mapping are small areas of Chaska and Ethan soils. These soils make up less than 10 percent of any one mapped area. The somewhat poorly drained Chaska soils are in drainageways. Ethan soils do not have dark colors below a depth of 20 inches. They are on uplands.

The content of organic matter and fertility are high in the Davis soil. Permeability is moderate. Available water capacity is high. Runoff is medium. The shrink-swell potential is moderate.

Most of the acreage is cropland. This soil is well suited to cultivated crops. Measures that control erosion are the main management needs. Examples are minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system. Other examples are grassed waterways, contour farming, and terraces.

This soil is well suited to tame pasture and hay. Alfalfa, Garrison creeping foxtail, intermediate wheatgrass, reed canarygrass, and smooth bromegrass grow well.

This soil is well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs grow well, especially those that require an abundant moisture supply.

Because of the moderate shrink-swell potential, this soil is only fairly well suited to most kinds of building site development. Backfilling with gravelly material, providing foundation drains, and diverting runoff away from buildings, however, help to prevent the structural damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. Because of the restricted permeability, the soil is only fairly well suited to septic tank absorption fields. Enlarging the absorption area, however, helps to overcome the slow absorption of liquid waste.

The capability unit is IIe-1; Silty range site.

DbA—Davis loam, sandy substratum, 0 to 2 percent slopes. This well drained, nearly level soil is on flood plains. It is subject to rare flooding for brief periods after heavy rainfall or rapid snowmelt. It is moderately deep over gravelly material. Areas are 5 to more than 400 acres in size and are irregular in shape.

Typically, the surface layer is dark gray loam about 10 inches thick. The subsoil is about 26 inches thick. The upper part is very dark gray, friable loam; the next part is very dark grayish brown, friable loam; and the lower part is dark grayish brown, very friable sandy loam. The underlying material to a depth of 60 inches is grayish brown and brown, calcareous gravelly loamy sand, loamy sand, sand, and gravelly sand. In some areas the surface layer and subsoil contain more silt and less clay.

Included with this soil in mapping are small areas of Blendon, Dimo, and Roxbury soils. These soils make up less than 15 percent of any one mapped area. Blendon soils contain less clay and more sand in the upper part than the Davis soil. They are on the upper side slopes. The somewhat poorly drained Dimo soils are in swales. Roxbury soils are deeper to gravelly material than the Davis soil. They are on the slightly lower parts of the landscape.

The content of organic matter and fertility are high in the Davis soil. Permeability is moderate in the upper part of the profile and rapid in the underlying gravelly material. Available water capacity is moderate. Runoff is slow. The shrink-swell potential is moderate in the upper part of the profile.

Most of the acreage is cropland. Many areas are irrigated. This soil is well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants. Measures that conserve moisture are the main management needs. Examples are minimizing tillage and leaving crop residue on the surface.

This soil is poorly suited to windbreaks and environmental plantings. Optimum survival and growth rates are unlikely because the underlying gravelly material limits the moisture supply.

This soil generally is unsuitable as a site for buildings and most sanitary facilities because of the flooding and a poor filtering capacity.

The capability unit is IIs-3; Silty range site.

DeA—Delmont-Enet loams, 0 to 2 percent slopes. These nearly level soils are on terraces. The somewhat excessively drained Delmont soil is shallow over gravelly material. It is on slight rises. The well drained Enet soil is moderately deep over gravelly material. It is in concave areas. Areas are 10 to several thousand acres in size and are irregular in shape. They are 55 to 70 percent Delmont soil and 25 to 40 percent Enet soil. The two soils occur as areas so closely intermingled or so small that mapping them seperately is not practical.

Typically, the surface layer of the Delmont soil is very dark gray loam about 8 inches thick. The subsoil is very dark grayish brown, very friable loam about 10 inches thick. The underlying material to a depth of 60 inches is multicolored, calcareous gravelly sand.

Typically, the surface layer of the Enet soil is very dark gray loam about 8 inches thick. The subsoil is about 16 inches thick. The upper part is very dark grayish brown, very friable loam, and the lower part is dark grayish brown, very friable fine sandy loam. The underlying material to a depth of 60 inches is grayish brown, calcareous gravelly loamy sand and multicolored, calcareous gravelly sand. In places the depth to gravelly material is more than 40 inches.

Included with these soils in mapping are small areas of Blendon, Dimo, and Talmo soils. These included soils make up less than 10 percent of any one mapped area. Blendon soils are more than 40 inches deep to gravelly material. They are in positions on the landscape similar to those of the Delmont and Enet soils. The somewhat poorly drained Dimo soils are in swales. Talmo soils have gravelly material within a depth of 14 inches. They are on knolls and ridges.

The content of organic matter is moderate and fertility medium in the Delmont and Enet soils. Permeability is moderate in the upper part of both soils and rapid in the underlying gravelly material. Available water capacity is low. Runoff is slow.

Most of the acreage is cropland. Most areas are irrigated. These soils are fairly well suited to cultivated crops. They are droughty because the rooting depth is limited by the underlying gravelly material. Minimizing tillage and leaving crop residue on the surface conserve moisture.

These soils are fairly well suited to tame pasture and hay. Suitable pasture plants are limited to drought resistant species, such as alfalfa, crested wheatgrass, and pubescent wheatgrass.

These soils are poorly suited to windbreaks and environmental plantings. Trees and shrubs can be established, but optimum survival, growth, and vigor are unlikely.

These soils are fairly well suited to range. The native vegetation on the Delmont soil dominantly is needleandthread, little bluestem, and sedges. That on the Enet soil dominantly is big bluestem, little bluestem, and green needlegrass. Overused areas are dominated by blue grama, Kentucky bluegrass, and threadleaf sedge.

These soils are well suited to most kinds of building site development, but the sides of shallow excavations tend to cave in unless they are shored. The soils readily absorb but do not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the pollution of ground water. The soils are a probable source of sand and gravel for use as road construction material.

The Delmont soil is in capability unit IIIs-3, Shallow to Gravel range site; the Enet soil is in capability unit IIs-3, Silty range site.

DeB—Delmont-Enet loams, 2 to 6 percent slopes. These undulating soils are in areas on terraces where slopes generally are short and complex. The somewhat excessively drained Delmont soil is shallow over gravelly material. It generally is on the smooth and convex upper slopes. The well drained Enet soil is moderately deep over gravelly material. It generally is on the lower side slopes. Areas are 10 to more than 500 acres in size and are irregular in shape. They are about 50 to 60 percent Delmont soil and 30 to 40 percent Enet soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Delmont soil is very dark gray loam about 7 inches thick. The subsoil is very dark gray, very friable loam about 9 inches thick. The underlying material to a depth of 60 inches is grayish brown and light brownish gray, calcareous gravelly loamy sand.

Typically, the surface layer of the Enet soil is very dark gray loam about 7 inches thick. The subsoil is friable loam about 21 inches thick. The upper part is very dark gray, and the lower part is very dark grayish brown. The underlying material to a depth of 60 inches is grayish brown and yellowish brown, calcareous gravelly loamy sand. In places gravelly sand is below a depth of 40 inches.

Included with these soils in mapping are small areas of Dimo and Talmo soils. These included soils make up less than 15 percent of any one mapped area. The somewhat poorly drained Dimo soils are in swales. The excessively drained Talmo soils have gravelly material within a depth of 14 inches. They are on knolls and ridges.

The content of organic matter is moderate and fertility medium in the Delmont and Enet soils. Permeability is moderate in the subsoil of both soils and rapid in the underlying material. Available water capacity is low. Runoff is medium.

Most of the acreage is cropland. These soils are poorly suited to cultivated crops because they are droughty. Small grain and grasses are better suited than late maturing crops, such as corn. Measures that control erosion, conserve moisture, increase the content of organic matter, and improve fertility are the main management needs. Examples are minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system.

A cover of tame pasture plants or hay is effective in controlling erosion. These soils are fairly well suited to tame pasture and hay. Only those grasses that are drought resistant are suitable. Crested wheatgrass and pubescent wheatgrass are examples.

The Delmont soil is fairly well suited and the Enet soil well suited to range. The native vegetation on the Delmont soil dominantly is needleandthread, little bluestem, and sedges. That on the Enet soil dominantly is big bluestem, little bluestem, and needlegrass. Overused areas are dominated by blue grama, Kentucky bluegrass, and threadleaf sedge.

These soils are poorly suited to windbreaks and environmental plantings. Trees and shrubs can be established, but optimum survival, growth, and vigor are unlikely.

These soils are well suited to most kinds of building site development, but the sides of shallow excavations tend to cave in unless they are shored. The soils readily absorb but do not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the pollution of ground water. The soils are a probable source of sand and gravel for use as road construction material.

The Delmont soil is in capability unit IVs-2, Shallow to Gravel range site; the Enet soil is in capability unit IIIe-3, Silty range site.

DgB—Dempster-Graceville silty clay loams, 1 to 5 percent slopes. These well drained, undulating soils are on terraces. The Dempster soil is moderately deep and the Graceville soil deep over gravelly material. The Dempster soil is on the upper side slopes and knolls. The Graceville soil is on the smooth and concave lower side slopes and in swales. Slopes generally are short and complex. Areas are 5 to more than 50 acres in size and are irregular in shape. They are 60 to 70 percent Dempster soil and 20 to 30 percent Graceville soil. The two soils occur as areas so closely intermingled or so small that mapping them separatey is not practical.

Typically, the surface layer of the Dempster soil is dark grayish brown silty clay loam about 8 inches thick. The subsoil is about 26 inches thick. The upper part is dark grayish brown, friable silty clay loam; the next part is brown, friable silty clay loam; and the lower part is light brownish gray, friable, calcareous loam. The underlying material to a depth of 60 inches is brown, calcareous gravelly loamy sand and pale brown, mottled, calcareous gravelly sand. In some areas the upper part of the soil contains more sand.

Typically, the surface layer of the Graceville soil is very dark gray silty clay loam about 18 inches thick. The subsoil is friable silty clay loam about 34 inches thick. The upper part is dark gray and dark grayish brown, and the lower part is light brownish gray. The underlying material to a depth of 60 inches is dark brown, mottled gravelly loamy sand. In some areas the gravelly material is below a depth of 60 inches.

Included with these soils in mapping are small areas of Blendon, Delmont, Egan, and Henkin soils. These included soils make up less than 10 percent of any one mapped area. Blendon and Henkin soils contain more sand and less clay in the surface layer and subsoil than the Dempster and Graceville soils. They are in positions on the landscape similar to those of the Dempster and Graceville soils. Delmont soils have gravelly material 14 to 20 inches from the surface. They are on knolls. Egan soils are underlain by glacial till. They are in positions on the landscape similar to those of the Dempster soil.

The content of organic matter is moderate and fertility medium in the Dempster soil. The content of organic matter and fertility are high in the Graceville soil. Permeability is moderate in the upper part of both soils and rapid in the underlying material. Available water capacity is moderate in the Dempster soil and high in the Graceville soil. Runoff is medium on the Dempster soil and slow on the Graceville soil. The shrink-swell potential is moderate in the upper part of both soils.

Most of the acreage is cropland. The Dempster soil is fairly well suited and the Graceville soil well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants. The Dempster soil is better suited to small grain than to late-maturing crops, such as corn, because it is somewhat droughty. The Graceville soil has few limitations. Measures that control erosion and conserve moisture are the main management needs. Examples are minimizing tillage and leaving crop residue on the surface.

The Dempster soil is poorly suited and the Graceville soil well suited to windbreaks and environmental plantings. Optimum survival and growth are unlikely on the Dempster soil because it is droughty. Most climatically suited trees and shrubs can grow well on the Graceville soil.

These soils are only fairly well suited to most kinds of building site development because of the moderate shrink-swell potential and the tendency of shallow excavations to cave in unless they are shored. Backfilling with sandy material, diverting runoff away from buildings, and reinforcing foundations and footings help to prevent the structural damage caused by shrinking and swelling. The soils readily absorb the effluent in septic tank absorption fields, but the Dempster soil does not adequately filter the effluent. The poor filtering capacity may result in the pollution of ground water. The soils are a probable source of sand and gravel for use as road construction material.

The Dempster soil is in capability unit IIIs-2, Silty range site; the Graceville soil is in capability unit I-3, Overflow range site.

Do—Dimo clay loam. This somewhat poorly drained, nearly level soil is in swales on terraces. It is frequently flooded for very brief periods after heavy rainfall or rapid snowmelt. It is moderately deep over gravelly material. Areas are 5 to 90 acres in size and are long and narrow.

Typically, the surface layer is very dark gray clay loam about 9 inches thick. The subsoil is about 20 inches thick and is friable. The upper part is very dark gray clay loam; the next part is dark grayish brown, mottled loam; and the lower part is grayish brown, mottled, calcareous loam. The underlying material to a depth of 60 inches is light gray, mottled, calcareous gravelly loamy sand and multicolored, calcareous gravelly sand. In some areas the gravelly material is below a depth of 40 inches.

Included with this soil in mapping are small areas of Clamo, Delmont, and Enet soils. These soils make up less than 15 percent of any one mapped area. The poorly drained Clamo soils contain more clay in the subsoil than the Dimo soil and are deeper to gravelly material. They are in positions on the landscape similar to those of the Dimo soil. The somewhat excessively drained Delmont and well drained Enet soils are higher on the landscape than the Dimo soil.

The content of organic matter and fertility are high in the Dimo soil. Permeability is moderate in the upper part of the profile and rapid in the underlying material. Available water capacity is moderate. A seasonal high water table is at a depth of 2 to 6 feet in the spring of most years. Runoff is slow. The shrink-swell potential is moderate in the subsoil.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants. The soil is somewhat droughty late in the summer because of the underlying gravelly material, but fieldwork is delayed in some years because of the wetness. Conserving moisture for use late in the growing season is the main concern in managing cultivated areas. Minimizing tillage and leaving crop residue on the surface conserve moisture.

This soil is well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs grow well.

Because of the seasonal high water table and the flooding, this soil generally is unsuitable as a site for buildings and sanitary facilities. It is a probable source of sand and gravel for use as road construction material.

The capability unit is IIs-3; Overflow range site.

EeA—Egan-Ethan complex, 0 to 2 percent slopes. These deep, well drained, nearly level soils are on uplands. The Egan soil is on the smooth parts of the landscape. The Ethan soil is in convex areas. Slopes generally are short and complex, but some are long and smooth. Scattered cobblestones are on some of the upper side slopes. Areas are 10 to more than 1,000 acres in size and are irregular in shape. They are 55 to 75 percent Egan soil and 15 to 25 percent Ethan soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Egan soil is very dark gray silty clay loam about 8 inches thick. The subsoil is about 28 inches thick. It is friable. The upper part is dark grayish brown silty clay loam; the next part is brown silty clay loam; and the lower part is grayish brown, calcareous clay loam. The underlying material to a depth of 60 inches is light yellowish brown, mottled, calcareous clay loam. In some areas the subsoil and underlying material contain more clay.

Typically, the surface layer of the Ethan soil is dark grayish brown loam about 8 inches thick. The next 13 inches is light brownish gray, friable clay loam. The underlying material to a depth of 60 inches is light gray and pale yellow, mottled clay loam. The soil is calcareous throughout. In places the surface layer is less than 5 inches thick.

Included with these soils in mapping are small areas of Chancellor, Tetonka, and Trent soils. These included soils make up less than 10 percent of any one mapped area. The somewhat poorly drained Chancellor soils are

in swales and shallow drainageways. The poorly drained Tetonka soils are in depressions. The moderately well drained Trent soils are dark to a depth of more than 20 inches. They are in swales.

The content of organic matter is moderate and fertility medium in the Egan soil. The content of organic matter and fertility are low in the Ethan soil. Permeability is moderate in the upper part of both soils and moderately slow in the underlying material. Available water capacity is high. Runoff is slow. The shrink-swell potential is moderate.

Most of the acreage is cropland. The Egan soil is well suited and the Ethan soil fairly well suited to cultivated crops. The Egan soil has few limitations. The high content of lime in the surface layer of the Ethan soil adversely affects the availability of plant nutrients. Controlling erosion, improving fertility, and increasing the content of organic matter are the main management concerns. Conserving moisture also is a concern. Minimizing tillage, leaving crop residue on the surface, applying animal manure, and including grasses and legumes in the cropping system help to control erosion, improve fertility, increase the content of organic matter, and conserve moisture.

The Egan soil is well suited and the Ethan soil fairly well suited to tame pasture and hay. Production is limited on the Ethan soil because the high content of lime in the surface layer adversely affects the availability of plant nutrients. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants.

These soils are fairly well suited to windbreaks and environmental plantings. Except for those that require an abundant supply of moisture, all climatically suited trees and shrubs grow well on the Egan soil. Trees and shrubs can be established on the Ethan soil, but optimum survival, growth, and vigor are unlikely.

These soils are fairly well suited to most kinds of building site development and sanitary facilities. The moderate shrink-swell potential is a limitation on building sites and the restricted permeability a limitation in septic tank absorption fields. Backfilling with sandy material, providing foundation drains, and diverting runoff away from buildings help to prevent the structural damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. Enlarging the absorption area in septic tank absorption fields helps to overcome the slow absorption of liquid waste.

The Egan soil is in capability unit I-2, and the Ethan soil is in capability unit IIe-4; both soils are in Silty range site.

EeB—Egan-Ethan complex, 2 to 6 percent slopes. These deep, well drained, undulating soils are on uplands where slopes generally are short and complex. Some areas are dissected by well defined drainageways. A few scattered cobbles and stones are on the surface in some areas. The Egan soil is on side slopes. The Ethan soil is on the upper side slopes and knolls. Areas are 5 to several thousand acres in size and are irregular in shape. They are 50 to 70 percent Egan soil and 20 to 40 percent Ethan soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Egan soil is very dark gray silty clay loam about 8 inches thick. The subsoil is about 28 inches thick. It is friable. The upper part is dark grayish brown silty clay loam; the next part is brown silty clay loam; and the lower part is grayish brown, calcareous clay loam. The underlying material to a depth of 60 inches is light yellowish brown, mottled, calcareous clay loam. In some areas it contains more silt.

Typically, the surface layer of the Ethan soil is dark grayish brown loam about 8 inches thick. The next 13 inches is light brownish gray, friable clay loam. The underlying material to a depth of 60 inches is light gray and pale yellow, mottled clay loam. The soil is calcareous throughout. In places the surface layer is less than 5 inches thick.

Included with these soils in mapping are small areas of Chancellor, Dempster, Tetonka, Trent, and Worthing soils. These included soils make up less than 15 percent of any one mapped area. The somewhat poorly drained Chancellor soils are in swales and shallow drainageways. Dempster soils have gravelly material 20 to 40 inches from the surface. They are in positions on the landscape similar to those of the Ethan soil. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions. The moderately well drained Trent soils are dark to a depth of more than 20 inches. They are in swales.

The content of organic matter is moderate and fertility medium in the Egan soil. The content of organic matter and fertility are low in the Ethan soil. Permeability is moderate in the upper part of both soils and moderately slow in the underlying material. Available water capacity is high. Runoff is medium. The shrink-swell potential is moderate.

Most of the acreage is cropland. These soils are well suited to cultivated crops. The main concerns of management are controlling erosion and conserving moisture. Increasing the content of organic matter and improving fertility are other management concerns. The high content of lime in the surface layer of the Ethan soil adversely affects the availability of plant nutrients. Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to control erosion, conserve moisture, improve fertility, and increase the content of organic matter. Contour farming, grassed waterways, and terraces also can help to control erosion, but in some areas the slopes are too short or too irregular for contouring and terracing.

The Egan soil is well suited and the Ethan soil fairly well suited to tame pasture and hay. Production is limited on the Ethan soil because the high content of lime in the surface layer adversely affects the availability of plant nutrients. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants.

These soils are fairly well suited to windbreaks and environmental plantings. Except for those that require an abundant supply of moisture, all climatically suited trees and shrubs grow well on the Egan soil. Trees and shrubs can be established on the Ethan soil, but optimum survival, growth, and vigor are unlikely. Planting on the contour helps to control erosion and conserves moisture.

These soils are fairly well suited to most kinds of building site development and sanitary facilties. The moderate shrink-swell potential is a limitation on building sites and the restricted permeability a limitation in septic tank absorption fields. Backfilling with sandy material, providing foundation drains, and diverting runoff away from buildings help to prevent the structural damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. Enlarging the absorption area in septic tank absorption fields helps to overcome the slow absorption of liquid waste.

The Egan soil is in capability unit IIe-3, and the Ethan soil is in capability unit IIIe-6; both soils are in Silty range site.

EfA—Egan-Trent silty clay loams, 0 to 2 percent slopes. These deep, nearly level soils are on uplands. The well drained Egan soil is on the smooth and convex middle and upper side slopes. The moderately well drained Trent soil is in swales. It is frequently flooded for very brief periods after heavy rainfall or rapid snowmelt. Areas are 25 to more than 1,000 acres in size and are irregular in shape. They are 65 to 75 percent Egan soil and 15 to 25 percent Trent soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Egan soil is very dark gray silty clay loam about 8 inches thick. The subsoil is friable silty clay loam about 22 inches thick. The upper part is very dark grayish brown, the next part is grayish brown, and the lower part is light brownish gray and calcareous. The underlying material to a depth of 60 inches is light brownish gray, mottled, calcareous silty clay loam and light gray, mottled, calcareous clay loam. In some areas it contains more silt and less sand.

Typically, the surface layer of the Trent soil is very dark gray silty clay loam about 12 inches thick. The subsoil is friable silty clay loam about 30 inches thick. The upper part is very dark grayish brown; the next part is grayish brown; and the lower part is light brownish gray, mottled, and calcareous. The underlying material to a depth of 60 inches is light gray, mottled, calcareous silty clay loam. In some areas it contains more sand.

Included with these soils in mapping are small areas of Chancellor, Tetonka, and Wakonda soils. These included soils make up less than I5 percent of any one mapped area. The somewhat poorly drained Chancellor soils are in swales and shallow drainageways. The poorly drained Tetonka soils are in depressions. Wakonda soils have a high content of lime within a depth of 16 inches. They are on slight rises above the swales and depressions.

The content of organic matter is moderate and fertility medium in the Egan soil. The content of organic matter and fertility are high in the Trent soil. Permeability is moderate in the upper part of the Egan soil and moderately slow in the underlying material. It is moderate in the Trent soil. Available water capacity is high in both soils. In the Trent soil a seasonal high water table is at a depth of 3.5 to 6 feet in the spring of most years. Runoff is slow on both soils. The shrink-swell potential is moderate.

Most of the acreage is cropland. These soils are well suited to cultivated crops and to tame pasture and hay. They have few limitations, but in some years fieldwork may be delayed on the Trent soil because of runoff from adjacent soils. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants.

These soils are well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs grow well. Those that require an abundant moisture supply grow especially well on the Trent soil.

The Egan soil is fairly well suited and the Trent soil generally unsuited to most kinds of building site development and sanitary facilities. Because the Trent soil is subject to flooding, the Egan soil is a better site. Its moderate shrink-swell potential, however, is a limitation on building sites and its restricted permeability a limitation in septic tank absorption fields. Backfilling with sandy material, providing foundation drains, and diverting runoff away from buildings help to prevent the structural damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. Enlarging the absorption area in septic tank absorption fields helps to overcome the slow absorption of liquid waste.

The capability unit is I-2; the Egan soil is in Silty range site and the Trent soil in Overflow range site.

EgB—Egan-Wentworth silty clay loams, 2 to 6 percent slopes. These deep, well drained, undulating soils are in areas on uplands where slopes generally are long and smooth. Some areas are dissected by well defined drainageways. The Egan soil is on the upper side slopes. The Wentworth soil is on the lower side slopes. Areas are 10 to more than 500 acres in size and are irregular in shape. They are 50 to 60 percent Egan soil and 30 to 40 percent Wentworth soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Egan soil is very dark grayish brown silty clay loam about 8 inches thick. The subsoil is friable silty clay loam about 18 inches thick. The upper part is grayish brown, and the lower part is light brownish gray and calcareous. The underlying material to a depth of 60 inches is light gray, mottled, calcareous clay loam. In some areas the surface layer and subsoil contain more sand.

Typically, the surface layer of the Wentworth soil is very dark gray silty clay loam about 8 inches thick. The subsoil is friable silty clay loam about 28 inches thick. The upper part is very dark grayish brown, the next part is grayish brown, and the lower part is light yellowish brown and calcareous. The underlying material to a depth of 60 inches is light yellowish brown, mottled, calcareous silty clay loam and clay loam.

Included with these soils in mapping are small areas of Chancellor, Dempster, Ethan, Tetonka, and Trent soils. These included soils make up less than 15 percent of any one mapped area. The somewhat poorly drained Chancellor soils are in swales and shallow drainageways. Dempster soils have gravelly material 20 to 40 inches from the surface. They are in positions on the landscape similar to those of the Egan and Wentworth soils. Ethan soils have free carbonates at or near the surface. They are on the upper side slopes and knolls. The poorly drained Tetonka soils are in depressions. The moderately well drained Trent soils are dark to a depth of more than 20 inches. They are in swales.

The content of organic matter is moderate and fertility medium in the Egan and Wentworth soils. Permeability is moderate in the upper part of both soils and moderately slow in the underlying material. Available water capacity is high. Runoff is medium. The shrink-swell potential is moderate.

Most of the acreage is cropland. These soils are well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants. Controlling erosion is the main management concern. Conserving moisture also is a concern. Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system help to control erosion and conserve moisture. Contour farming, grassed waterways, and terraces also help to control erosion.

These soils are well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs grow well. Planting on the contour helps to control erosion and conserves moisture.

These soils are only fairly well suited to most kinds of building site development and sanitary facilities. The moderate shrink-swell potential is a limitation on building sites and the restricted permeability a limitation in septic tank absorption fields. Backfilling with sandy material, providing foundation drains, and diverting runoff away from buildings help to prevent the structural damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. Enlarging the absorption area in septic tank absorption fields helps to overcome the slow absorption of liquid waste.

The capability unit is IIe-3; Silty range site.

EnA—Enet loam, 0 to 2 percent slopes. This well drained, nearly level soil is in areas on terraces where slopes generally are long and smooth. It is moderately deep over gravelly material. Areas are 10 to more than 500 acres in size and are irregular in shape.

Typically, the surface layer is very dark gray loam about 8 inches thick. The subsoil is about 22 inches thick. It is very friable. The upper part is very dark gray loam, the next part is very dark grayish brown loam, and the lower part is brown sandy loam. The underlying material to a depth of 60 inches is pale brown and yellowish brown, calcareous gravelly sand. In some areas gravelly material is 14 to 20 inches from the surface.

Included with this soil in mapping are small areas of Dimo soils. These soils make up less than 10 percent of any one mapped area. They are somewhat poorly drained and are in swales.

The content of organic matter is moderate and fertility medium in the Enet soil. Permeability is moderate in the upper part of the profile and rapid in the underlying gravelly material. Available water capacity is low. Runoff is slow.

Most of the acreage is cropland. Many areas are irrigated. This soil is well suited to cultivated crops, but it is droughty late in the growing season because of the moderate depth to gravelly material. Minimizing tillage and leaving crop residue on the surface conserve moisture.

This soil is well suited to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass grow well, but production may be limited in years of low rainfall.

This soil is poorly suited to windbreaks and environmental plantings. Trees and shrubs can be established, but optimum survival, growth, and vigor are unlikely. Drought resistant trees and shrubs should be selected for planting.

This soil is well suited to most kinds of building site development, but the sides of shallow excavations tend to cave in unless they are shored. The soil readily absorbs but does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the pollution of ground water. The soil is a probable source of sand and gravel for use as road construction material.

The capability unit is IIs-3; Silty range site.

EsD—Ethan-Betts loams, 6 to 15 percent slopes. These deep, well drained, moderately sloping and strongly sloping soils are mainly on upland breaks along

the major streams. Well defined drainageways dissect most areas. In some areas scattered stones are on the surface. The Ethan soil is on the smooth middle and lower side slopes and on some of the broader ridges. The Betts soil is on convex slopes. Areas are 5 to 250 acres in size and are irregular in shape. They are 50 to 60 percent Ethan soil and 30 to 40 percent Betts soil. These two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Ethan soil is dark grayish brown loam about 8 inches thick. The next 13 inches is light brownish gray, friable, calcareous clay loam. The underlying material to a depth of 60 inches is light gray and pale yellow, mottled, calcareous clay loam.

Typically, the surface layer of the Betts soil is dark grayish brown, calcareous loam about 4 inches thick. The next 5 inches is grayish brown, friable, calcareous clay loam. The underlying material to a depth of 60 inches is light brownish gray, mottled, calcareous clay loam.

Included with these soils in mapping are small areas of Chaska, Clarno, Davis, and Talmo soils. These included soils make up less than 15 percent of any one mapped area. The somewhat poorly drained Chaska soils are in drainageways. Clarno soils have free carbonates more than 12 inches from the surface. They are in positions on the landscape similar to those of the Ethan soil. Davis soils are dark to a depth of more than 20 inches. They are on fans and foot slopes. Talmo soils are underlain by gravelly material within a depth of 14 inches. They are in positions on the landscape similar to those of the Betts soil.

The content of organic matter and fertility are low in the Ethan and Betts soils. Permeability is moderate in the upper part of both soils and moderately slow in the underlying material. Available water capacity is high. Runoff is rapid. The shrink-swell potential is moderate.

Most of the acreage supports native grasses. These soils are well suited to range. The native vegetation dominantly is little bluestem and needlegrass. Overused areas are dominated by blue grama, needleandthread, Kentucky bluegrass, and sedges.

These soils generally are unsuitable for crops and tame pasture and hay because of the slope. Pasture plants can be established in the less sloping areas, but production is limited by the adverse effect of the high content of lime in the surface layer. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants.

Windbreaks and environmental plantings can be established in the less sloping areas of the Ethan soil, but optimum growth and survival are unlikely because of the high content of lime in the surface layer. Planting trees and shrubs on the contour helps to control erosion.

These soils are poorly suited to most kinds of building site development and sanitary facilities. The moderate shrink-swell potential and the slope are limitations on building sites, and the restricted permeability and the slope are limitations in septic tank absorption fields. Buildings constructed on these soils should be designed to conform to the natural slope of the land. Land shaping may be needed in some areas. Backfilling with sandy material, providing foundation drains, and diverting runoff away from buildings help to prevent the structural damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. Enlarging the absorption area in septic tank absorption fields helps to overcome the slow absorption of liquid waste. Land shaping and installing the distribution lines across the slope generally improve the efficiency of the absorption field.

The capability unit is VIe-3; the Ethan soil is in Silty range site and the Betts soil in Thin Upland range site.

EtB—Ethan-Egan complex, 2 to 6 percent slopes. These deep, well drained, undulating soils are in areas on uplands where slopes generally are short and complex. Some areas are dissected by well defined drainageways. The Ethan soil is on the upper side slopes and knolls (fig 8). A few scattered cobbles and stones are on the surface in some areas. The Egan soil is on the smooth lower side slopes. Areas are 5 to several thousand acres in size and are irregular in shape. They are 45 to 65 percent Ethan soil and 25 to 45 percent Egan soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Ethan soil is dark grayish brown loam about 8 inches thick. The next 13 inches is light brownish gray, friable clay loam. The underlying material to a depth of 60 inches is light gray and pale yellow, mottled clay loam. The soil is calcareous throughout. In places the surface layer is less than 5 inches thick.

Typically, the surface layer of the Egan soil is very dark grayish brown silty clay loam about 9 inches thick. The subsoil is about 19 inches thick. It is friable. The upper part is grayish brown silty clay loam, and the lower part is light brownish gray, calcareous clay loam. The underlying material to a depth of 60 inches is light gray and pale yellow, mottled, calcareous clay loam.

Included with these soils in mapping are small areas of Chancellor, Clarno, Tetonka, Trent, and Worthing soils. These included soils make up less than 15 percent of any one mapped area. The somewhat poorly drained Chancellor soils are in swales and shallow drainageways. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions. The moderately well drained Trent soils are dark to a depth of more than 20 inches. They are in swales.

The content of organic matter and fertility are low in the Ethan soil. The content of organic matter is

Figure 8.—An area of Ethan-Egan complex, 2 to 6 percent slopes. The light colored Ethan soil is on convex slopes and the dark colored Egan soil on smooth side slopes.

moderate and fertility medium in the Egan soil. Permeability is moderate in the upper part of both soils and moderately slow in the underlying material. Available water capacity is high. Runoff is medium. The shrink-swell potential is moderate.

Most of the acreage is cropland. These soils are well suited to cultivated crops. The high content of lime in the surface layer of the Ethan soil adversely affects the availability of plant nutrients. The main management concerns are controlling erosion, conserving moisture, and improving fertility. Minimizing tillage, leaving crop residue on the surface, applying animal manure, and including grasses and legumes in the cropping system help to control erosion, conserve moisture, improve fertility, and increase the content of organic matter. Contour farming, grassed waterways, and terraces also can help to control erosion, but in some areas the slopes are too short or too irregular for contouring and terracing.

The Ethan soil is fairly well suited and the Egan soil well suited to tame pasture and hay. Production is limited on the Ethan soil because the high content of lime in the surface layer adversely affects the availability of plant nutrients. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants.

These soils are fairly well suited to windbreaks and environmental plantings. Trees and shrubs can be established on the Ethan soil, but optimum survival, growth, and vigor are unlikely. Except for those that require an abundant supply of moisture, all climatically suited trees and shrubs grow well on the Egan soil. Planting on the contour helps to control erosion and conserves moisture.

These soils are fairly well suited to most kinds of building site development and sanitary facilities. The moderate shrink-swell potential is a limitation on building sites and the restricted permeability a limitation in septic tank absorption fields. Backfilling with sandy material, providing foundation drains, and diverting runoff away from buildings help to prevent the structural damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. Enlarging the absorption area in septic tank absorption fields helps to overcome the slow absorption of liquid waste.

The Ethan soil is in capability unit IIIe-6, and the Egan soil is in capability unit IIe-3; both soils are in Silty range site.

EtC—Ethan-Egan complex, 5 to 9 percent slopes. These deep, well drained, gently sloping and gently rolling soils are in areas on uplands where slopes are short and complex. Well defined drainageways dissect some areas. The Ethan soil is on the upper side slopes and knolls. A few scattered cobbles and stones are on the surface in some areas. The Egan soil is on the lower side slopes. Areas are 5 to more than 500 acres in size and are irregular in shape. They are 50 to 70 percent Ethan soil and 20 to 40 percent Egan soil. The two soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Ethan soil is dark grayish brown loam about 8 inches thick. The next 13 inches is light brownish gray, friable clay loam. The underlying material to a depth of 60 inches is light gray and pale yellow, mottled clay loam. The soil is calcareous throughout. In places the surface layer is less than 5 inches thick.

Typically, the surface layer of the Egan soil is very dark grayish brown silty clay loam about 8 inches thick. The subsoil is about 19 inches thick. It is friable. The upper part is grayish brown silty clay loam, and the lower part is light brownish gray, calcareous clay loam. The underlying material to a depth of 60 inches is light gray and pale yellow, mottled, calcareous clay loam.

Included with these soils in mapping are small areas of Chancellor, Delmont, Tetonka, and Worthing soils. These included soils make up less than 10 percent of any one mapped area. The somewhat poorly drained Chancellor soils are in swales and shallow drainageways. Delmont soils have gravelly material 14 to 20 inches from the surface. They are in positions on the landscape similar to those of the Ethan soil. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions.

The content of organic matter and fertility are low in the Ethan soil. The content of organic matter is moderate and fertility medium in the Egan soil. Permeability is moderate in the upper part of both soils and moderately slow in the underlying material. Available water capacity is high. Runoff is medium. The shrink-swell potential is moderate.

Most of the acreage is cultivated or used for pasture or hay. These soils are poorly suited to cultivated crops. The high content of lime in the surface layer of the Ethan soil adversely affects the availability of plant nutrients. Controlling erosion and improving fertility are the main management concerns. Conserving moisture also is a concern. Minimizing tillage, leaving crop residue on the surface, applying animal manure, and including grasses and legumes in the cropping system help to control erosion, conserve moisture, improve fertility, and increase the content of organic matter. Contour farming, terraces, and grassed waterways also help to control erosion, but in some areas the slopes are too short or too irregular for contouring and terracing.

These soils are fairly well suited to tame pasture and hay. Production is limited on the Ethan soil because the high content of lime in the surface layer adversely affects the availability of plant nutrients. Alfalfa, intermediate wheatgrass, and smooth bromegrass are the best suited species.

These soils are poorly suited to windbreaks and environmental plantings. No trees or shrubs grow well on the Ethan soil. Except for those that require an abundant supply of moisture, all climatically suited trees and shrubs grow well on the Egan soil. Planting on the contour helps to control erosion.

These soils are well suited to range. The native vegetation dominantly is needlegrass, big bluestem, and little bluestem. Overused areas are dominated by western wheatgrass, blue grama, and Kentucky bluegrass.

Because of the moderate shrink-swell potential, these soils are only fairly well suited to most kinds of building site development. Backfilling with gravelly material, providing foundation drains, and diverting runoff away from buildings, however, help to prevent the structural damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. Land shaping is needed in some areas. Because of the slope and the restricted permeability, the soils are only fairly well suited to most sanitary facilities. Enlarging the absorption area in septic tank absorption fields helps to overcome the slow absorption of liquid waste. Land shaping and installing the distribution lines across the slope generally improve the efficiency of the absorption field.

The Ethan soil is in capability unit IVe-2, and the Egan soil is in capability unit IIIe-2; both soils are in Silty range site.

HuA—Huntimer silty clay loam, 0 to 2 percent slopes. These deep, well drained, nearly level soils are on uplands. Areas are 5 to more than 60 acres in size and are circular.

Typically, the surface layer is very dark gray silty clay loam about 8 inches thick. The subsoil is dark grayish brown and grayish brown silty clay about 18 inches thick. It is calcareous in the lower part. The underlying material to a depth of 60 inches is light gray, mottled, calcareous silty clay loam stratified with thin layers of loam and clay loam.

Included with this soil in mapping are small areas of Chancellor, Ethan, and Tetonka soils. These soils make up less than 10 percent of any one mapped area. The somewhat poorly drained Chancellor soils are in swales. Ethan soils have free carbonates at or near the surface. They are in convex areas adjacent to the Huntimer soil. The poorly drained Tetonka soils are in depressions.

The content of organic matter is moderate and fertility medium in the Huntimer soil. Permeability is slow. Available water capacity is high. Runoff is slow. The shrink-swell potential is high.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants. The soil becomes compacted if tilled when wet. Increasing the water intake rate is the main concern of management. Conserving moisture also is a concern. Leaving crop residue on the surface, including grasses and legumes in the cropping system, and deferring tillage when the soil is wet increase the water intake rate and conserve moisture.

This soil is well suited to windbreaks and environmental plantings. Except for those that require an abundant supply of moisture, all climatically suited trees and shrubs grow well.

This soil is poorly suited to most kinds of building site development because of the high shrink-swell potential. Backfilling with gravelly material, providing foundations drains, and diverting runoff away from buildings, however, help to prevent the structural damage caused by shrinking and swelling. Reinforcing foundations and footings also helps to prevent this damage. Because of the restricted permeability, the soil is poorly suited to septic tank absorption fields. Enlarging the absorption area, however, helps to overcome the slow absorption of liquid waste.

The capability unit is IIs-2; Clayey range site.

La—Lamo silty clay loam. This deep, somewhat poorly drained, nearly level soil is on flood plains. It is occasionally flooded for brief periods after heavy rainfall or rapid snowmelt. Areas are 5 to more than 1,000 acres in size and are irregular in shape.

Typically, the surface layer is very dark gray silty clay loam about 8 inches thick. The subsurface layer is dark gray silty clay loam about 7 inches thick. The next 12 inches is dark gray, friable silty clay loam. The underlying material to a depth of 60 inches is light brownish gray and gray, mottled silty clay loam. It has accumulations of gypsum. The soil is calcareous throughout. In some areas the content of clay is higher throughout the profile.

Included with this soil in mapping are small areas of Roxbury and Salmo soils. These soils make up less than 15 percent of any one mapped area. The well drained Roxbury soils are slightly higher on the flood plains than the Lamo soil. The poorly drained Salmo soils have visible salts near or at the surface. They are in positions on the landscape similar to those of the Lamo soil.

The content of organic matter and fertility are high in the Lamo soil. Permeability is moderately slow. Available water capacity is high. A seasonal high water table is at a depth of 1.5 to 3 feet in the spring of most years. Runoff is slow. The shrink-swell potential is moderate.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Alfalfa, Garrison creeping foxtail, intermediate wheatgrass, reed canarygrass, and smooth bromegrass are suitable pasture plants. Wetness delays fieldwork in the spring of some years, but drainage generally is adequate. The soil becomes compacted if cultivated when wet. Installing a drainage system helps to control the wetness during periods of heavy rainfall. Leaving crop residue on the surface, including grasses and legumes in the cropping system, and deferring tillage when the soil is wet help to prevent surface compaction.

This soil is well suited to windbreaks and environmental plantings. All climatically suited trees and shrubs can grow well. Those that require an abundant moisture supply grow especially well.

This soil generally is unsuitable as a site for buildings and sanitary facilities because of the wetness and the flooding.

The capability unit is IIw-3; Subirrigated range site.

Or—Orthents-Aquents complex. This map unit consists of soils in and near open excavations, 5 to 30 feet deep, from which sand and gravel have been removed. Areas are irregular in shape and range from 4 to 100 acres in size. Slopes are uneven and broken and range from nearly level on the bottoms of the excavations to almost vertical on the rims. Some of the bottoms are covered with water.

Orthents consist of mounds of mixed loamy and gravelly material adjacent to the excavations. Aquents are on the bottoms of the excavations. They are predominantly sand and gravel, but in areas where all of the sand and gravel has been removed, they are loam or clay loam glacial till or silty glacial drift. The bottoms and sides support little or no vegetation during periods when the sand and gravel are mined.

Most of the acreage is used only as a source of sand and gravel, which can be used for construction purposes. Some areas provide limited wildlife habitat. Abandoned excavations can be restored to range, tame pasture, or cropland if reclamation measures are applied. These measures include shaping the areas and using the mounds of overburden material as topsoil dressing. Applying fertilizer as needed helps to establish range or pasture.

The capability subclass is VIIIs-1; no range site is assigned.

Ro—Roxbury silt loam. This deep, well drained, nearly level soil is on flood plains. It is occasionally flooded for very brief periods after heavy rainfall or rapid snowmelt. Areas are 5 to more than 500 acres in size and are irregular in shape.

Typically, the surface layer is dark gray silt loam about 20 inches thick. The subsoil is grayish brown, friable silt loam about 16 inches thick. The underlying material to a

depth of 60 inches is light brownish gray loam and silt loam stratified with thin layers of fine sandy loam. It is mottled in the lower part. The soil is calcareous throughout. In some areas the content of sand is higher throughout the profile. In other areas the content of clay is higher in the underlying material.

Included with this soil in mapping are small areas of the somewhat poorly drained Chaska and Lamo soils. These soils make up less than 10 percent of any one mapped area. Chaska soils are in drainageways. Lamo soils are slightly lower on the flood plains than the Roxbury soil.

The content of organic matter and fertility are high in the Roxbury soil. Permeability is moderate. Available water capacity is high. Runoff is slow. The shrink-swell potential is moderate.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Alfalfa, Garrison creeping foxtail, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants. The soil has few limitations. Fieldwork is delayed in some years because of the flooding, but in most years the additional moisture is beneficial. Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system conserve moisture.

This soil is well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs grow well, especially those that require an abundant moisture supply.

This soil is generally unsuitable as a site for buildings and sanitary facilities because of the flooding.

The capability unit is I-1; Overflow range site.

Rv—Roxbury Variant silt loam. This deep, moderately well drained, nearly level soil is on flood plains. It is occasionally flooded for brief periods after heavy rainfall or rapid snowmelt. Areas are 10 to more than 500 acres in size and are irregular in shape.

Typically, the surface layer is very dark gray silt loam about 8 inches thick. The subsurface layer is silt loam about 16 inches thick. The upper part is very dark gray, and the lower part is grayish brown and calcareous. The subsoil is about 21 inches of very dark gray, firm silty clay and clay. The underlying material to a depth of 60 inches is grayish brown, mottled clay loam. In some areas the subsoil and underlying material contain less clay.

Included with this soil in mapping are small areas of Chaska and Clamo soils. These soils make up less than 10 percent of any one mapped area. The somewhat poorly drained Chaska soils are in drainageways. The poorly drained Clamo soils are slightly lower on the flood plains than the Roxbury Variant soil. Also, they have a higher content of clay in the upper part.

The content of organic matter and fertility are high in the Roxbury Variant soil. Permeability is moderate in the upper part of the soil and slow in the lower part. Available water capacity is high. A seasonal high water table is at a depth of 4 to 6 feet in the spring of most years. Runoff is slow. The shrink-swell potential is moderate in the upper part of the soil and high in the lower part.

Most of the acreage is cropland. This soil is well suited to cultivated crops and to tame pasture and hay. Alfalfa, Garrison creeping foxtail, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants. The soil has few limitations. Fieldwork is delayed in some years because of the flooding, but in most years the additional moisture is beneficial. Minimizing tillage, leaving crop residue on the surface, and including grasses and legumes in the cropping system conserve moisture.

This soil is well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs grow well, especially those that require an abundant moisture supply.

This soil is generally unsuitable as a site for buildings and sanitary facilities because of the flooding.

The capability unit is I-1; Overflow range site.

Sa—Salmo silty clay loam. This deep, poorly drained, level soil is on flood plains. It is frequently flooded for brief periods after heavy rainfall or rapid snowmelt. Areas are 5 to more than 500 acres in size and are irregular in shape.

Typically, the surface layer is very dark gray silty clay loam about 3 inches thick. The subsurface layer is silty clay loam about 25 inches thick. It is very dark gray in the upper part and dark gray in the lower part. Accumulations of gypsum and other salts are throughout the surface layer and subsurface layer. The underlying material to a depth of 60 inches is dark gray silty clay loam and clay loam. It has accumulations of gypsum in the upper part. The soil is calcareous throughout. In some areas gravelly material is below a depth of 40 inches.

Included with this soil in mapping are small areas of Baltic and Lamo soils. These soils make up less than 15 percent of any one mapped area. They do not have visible salts near the surface. They are in positions on the landscape similar to those of the Salmo soil.

The content of organic matter is high and fertility medium in the Salmo soil. Tilth is fair. Permeability is moderately slow. Available water capacity is high. A seasonal high water table is within a depth of 2.5 feet in the spring of most years. Runoff is very slow. The shrink-swell potential is moderate.

Most of the acreage supports native grasses. This soil is well suited to range. The native vegetation dominantly is big bluestem, little bluestem, and western wheatgrass. Overused areas are dominated by western wheatgrass and saltgrass.

This soil is poorly suited to cultivated crops. Because of the wetness in spring, late planted crops are better suited than early planted crops. The excess amount of

salts restricts crop growth during dry periods. The soil becomes compacted if cultivated when wet. Improving tilth is a management concern. A surface drainage system can improve the drainage in some areas, but artificial drainage is not feasible in most areas because suitable outlets are not available. Leaving crop residue on the surface and deferring tillage when the soil is wet improve tilth.

This soil is well suited to tame pasture and hay. Examples of suitable pasture plants are tall wheatgrass and western wheatgrass. Grazing when the soil is wet causes surface compaction, which results in poor aeration and reduced plant vigor.

This soil is generally unsuited to windbreaks and environmental plantings. The number of suitable species is limited because the soil is saline. If trees and shrubs are planted, optimum growth and survival are unlikely.

This soil generally is unsuitable as a site for buildings and sanitary facilities because of the flooding.

The capability unit is IVw-2; Subirrigated range site.

Te—Tetonka silt loam. This deep, poorly drained, level soil is in depressions in the uplands. It is ponded during periods of heavy rainfall or rapid snowmelt. Areas are 5 to 25 acres in size and are oval.

Typically, the surface layer is dark gray silt loam about 9 inches thick. The subsurface layer is gray and light gray silt loam about 9 inches thick. The subsoil is about 28 inches thick. The upper part is dark gray, firm silty clay, and the lower part is light brownish gray, mottled, friable, calcareous silty clay loam. The underlying material to a depth of 60 inches is light gray, mottled, calcareous silty clay loam. In places the soil does not have a light gray subsurface layer.

Included with this soil in mapping are small areas of Chancellor, Crossplain, Davison, and Wakonda soils. These soils make up less than 15 percent of any one mapped area. The somewhat poorly drained Chancellor and Crossplain soils are in swales and shallow drainageways. The moderately well drained Davison and Wakonda soils have a high content of lime within a depth of 16 inches. They are on slight rises above the Tetonka soil.

The content of organic matter and fertility are high in the Tetonka soil. Permeability is slow. Available water capacity is high. A seasonal high water table is within a depth of 1 foot part of the year. As much as 1 foot of water ponds on the surface during some wet periods. Runoff is ponded. The shrink-swell potential is high.

Most of the acreage is cropland. If drained, this soil is well suited to cultivated crops. Because of the wetness, it is better suited to late planted crops than to other crops. In undrained areas, crops drown and tillage is delayed for long periods in some years.

This soil is fairly well suited to range. The native vegetation dominantly is sedges, reedgrass, and prairie cordgrass. Overused areas are dominated by foxtail barley, spikesedge, and rushes. Many areas are potential sites for excavated ponds.

This soil is well suited to tame pasture and hay, but only the water tolerant pasture plants grow well in undrained areas. Garrison creeping foxtail and reed canarygrass are the best suited species. All climatically suited pasture plants grow well in drained areas.

Unless drained, this soil generally is unsuited to windbreaks and environmental plantings. It is unsuitable as a site for buildings and most sanitary facilities because of the ponding.

The capability unit is IVw-2, IIw-1 if the soil is drained; Wet Meadow range site.

WaA—Wakonda-Wentworth-Chancellor silty clay loams, 0 to 3 percent slopes. These deep, nearly level and gently undulating soils are on uplands. The moderately well drained Wakonda and Wentworth soils are in convex areas and the upper side slopes. The somewhat poorly drained Chancellor soil is in swales and shallow drainageways. It receives runoff from adjacent soils and is frequently flooded for brief periods after heavy rainfall or rapid snowmelt. Areas are 10 to several thousand acres in size and are irregular in shape. They are 35 to 50 percent Wakonda soil, 25 to 40 percent Wentworth soil, and 15 to 30 percent Chancellor soil. The three soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Wakonda soil is dark gray silty clay loam about 8 inches thick. The next 7 inches is dark gray and olive brown, friable silty clay loam. The underlying material to a depth of 60 inches is light brownish gray, mottled silty clay loam and light yellowish brown and pale yellow, mottled loam and clay loam. It has accumulations of gypsum in the lower part. The soil is calcareous throughout.

Typically, the surface layer of the Wentworth soil is very dark gray silty clay loam about 9 inches thick. The subsoil is friable silty clay loam about 21 inches thick. The upper part is dark grayish brown; the next part is grayish brown; and the lower part is light brownish gray, mottled, and calcareous. The underlying material to a depth of 60 inches is pale yellow, mottled silty clay loam and light gray, mottled clay loam. In some areas the soil is well drained.

Typically, the surface layer of the Chancellor soil is very dark gray silty clay loam about 11 inches thick. The subsoil is about 25 inches thick. The upper part is very dark gray, firm silty clay; the next part is dark gray mottled, firm silty clay; and the lower part is light brownish gray, mottled, friable silty clay loam. The underlying material to a depth of 60 inches is light yellowish brown and light gray, mottled, calcareous silty clay loam. It has accumulations of gypsum in the lower part.

Included with these soils in mapping are small areas of Tetonka, Trent, and Worthing soils. These included soils make up less than 15 percent of any one mapped area. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions. The moderately well drained Trent soils are dark to a depth of more than 20 inches. They are in swales.

The content of organic matter is moderate in the Wakonda and Wentworth soils and high in the Chancellor soil. Fertility is low in the Wakonda soil, medium in the Wentworth soil, and high in the Chancellor soil. Permeability is moderate in the subsoil of the Wakonda and Wentworth soils and moderately slow in the underlying material. It is slow in the Chancellor soil. Available water capacity is high in all three soils. A seasonal high water table is at a depth of 1.5 to 4 feet in the Wakonda soil, at a depth of 3 to 6 feet in the Wentworth soil, and within a depth of 3 feet in the Chancellor soil. Runoff is slow on all three soils. The shrink-swell potential is moderate in the Wakonda and Wentworth soils and high in the Chancellor soil.

Most of the acreage is cropland. These soils are well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants. The Wentworth soil has few limitations. Planting may be delayed in some years because of the wetness in the Chancellor and Wakonda soils. The high content of lime in the surface layer of the Wakonda soil adversely affects the availability of plant nutrients. The Chancellor soil becomes compacted if cultivated when wet. A surface drainage system that controls the wetness of the Chancellor soil is the main management need. Measures that conserve moisture and improve fertility also are needed. Examples are minimizing tillage, leaving crop residue on the surface, applying animal manure, and including grasses and legumes in the cropping system.

These soils are well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs can grow well. Those that require an abundant moisture supply grow especially well on the Chancellor soil.

The Wakonda and Chancellor soils generally are unsuited and the Wentworth soil poorly suited to most kinds of building site development. The wetness is the main limitation. Also, flooding is a hazard on the Chancellor soil and the moderate shrink-swell potential a limitation in the Wentworth soil. Backfilling with gravelly material, reinforcing foundations and footings, diverting runoff away from buildings, and installing a subsurface drainage system help to prevent the structural damage caused by the shrinking and swelling and temporary wetness of the Wentworth soil. Foundation drains also reduce the wetness.

These soils generally are unsuitable as sites for septic tank absorption fields because of the wetness.

The Wakonda soil is in capability unit IIe-4, Limy Subirrigated range site; the Wentworth soil is in capability unit I-2, Silty range site; and the Chancellor soil is in capability unit IIw-1, Overflow range site.

WcA—Wentworth-Chancellor-Wakonda silty clay loams, 0 to 2 percent slopes. These deep, nearly level soils are on uplands. The moderately well drained Wentworth and Wakonda soils are in convex areas and on the upper side slopes. The somewhat poorly drained Chancellor soil is in swales and shallow drainageways. It receives runoff from adjacent soils and is frequently flooded for brief periods after heavy rainfall or rapid snowmelt. Areas are 10 to several thousand acres in size and are irregular in shape. They are 50 to 70 percent Wentworth soil, 15 to 30 percent Chancellor soil, and 10 to 20 percent Wakonda soil. The three soils occur as areas so closely intermingled or so small that mapping them separately is not practical.

Typically, the surface layer of the Wentworth soil is very dark gray silty clay loam about 9 inches thick. The subsoil is friable silty clay loam about 21 inches thick. The upper part is dark grayish brown; the next part is grayish brown; and the lower part is light brownish gray, mottled, and calcareous. The underlying material to a depth of 60 inches is pale yellow, mottled, calcareous silty clay loam and light gray, mottled, calcareous clay loam. In some areas the soil is well drained.

Typically, the surface layer of the Chancellor soil is very dark gray silty clay loam about 11 inches thick. The subsoil is about 25 inches thick. The upper part is very dark gray, firm silty clay; the next part is dark gray, mottled, firm silty clay; and the lower part is light brownish gray, mottled, friable silty clay loam. The underlying material to a depth of 60 inches is light yellowish brown and light gray, mottled, calcareous silty clay loam. It has accumulations of gypsum in the lower part.

Typically, the surface layer of the Wakonda soil is dark gray silty clay loam about 8 inches thick. The next 7 inches is dark gray and olive brown, friable silty clay loam. The underlying material to a depth of 60 inches is light brownish gray, mottled silty clay loam and light yellowish brown and pale yellow, mottled loam and clay loam. It has accumulations of gypsum in the lower part. The soil is calcareous throughout.

Included with these soils in mapping are small areas of Tetonka, Trent, and Worthing soils. These included soils make up less than 15 percent of any one mapped area. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions. The moderately well drained Trent soils are dark to a depth of more than 20 inches. They are in swales.

The content of organic matter is moderate in the Wentworth and Wakonda soils and high in the Chancellor soil. Fertility is medium in the Wentworth soil, low in the Wakonda soil, and high in the Chancellor soil.

Permeability is moderate in the subsoil of the Wentworth and Wakonda soils and moderately slow in the underlying material. It is slow in the Chancellor soil. Available water capacity is high in all three soils. A seasonal high water table is at a depth of 3 to 6 feet in the Wentworth soil, within a depth of 3 feet in the Chancellor soil, and at a depth of 1.5 to 4 feet in the Wakonda soil. Runoff is slow on all three soils. The shrink-swell potential is moderate in the Wentworth and Wakonda soils and high in the Chancellor soil.

Most of the acreage is cropland. These soils are well suited to cultivated crops and to tame pasture and hay. Alfalfa, intermediate wheatgrass, and smooth bromegrass are suitable pasture plants. The Wentworth soil has few limitations. Planting may be delayed in some years because of the wetness in the Chancellor and Wakonda soils. The Chancellor soil becomes compacted if cultivated when wet. The high content of lime in the surface layer of the Wakonda soil adversely affects the availability of plant nutrients. A surface drainage system that controls the wetness of the Chancellor soil is the main management need. Measures that conserve moisture and improve fertility also are needed. Examples are minimizing tillage, leaving crop residue on the surface, applying animal manure, and including grasses and legumes in the cropping system.

These soils are well suited to windbreaks and environmental plantings. Most climatically suited trees and shrubs can grow well. Those that require an abundant moisture supply grow especially well on the Chancellor soil.

The Wentworth soil is poorly suited and the Wakonda and Chancellor soils generally unsuited to most kinds of building site development. The wetness is the main limitation. Also, flooding is a hazard on the Chancellor soil and the moderate shrink-swell potential a limitation in the Wentworth soil. Backfilling with gravelly material, reinforcing foundations and footings, diverting runoff away from buildings, and installing a subsurface drainage system help to prevent the structural damage caused by the shrinking and swelling and temporary wetness of the Wentworth soil. Foundation drains also reduce the wetness.

These soils generally are unsuitable as sites for septic tank absorption fields because of the wetness.

The Wentworth soil is in capability unit I-2, Silty range site; the Chancellor soil is in capability unit IIw-1, Overflow range site; and the Wakonda soil is in capability unit IIe-4, Limy Subirrigated range site.

Wo—Worthing silty clay loam. This deep, very poorly drained, level soil is in depressions in the uplands. It is ponded during periods of heavy rainfall or rapid snowmelt. Areas are 5 to 60 acres in size and are oval.

Typically, the surface layer is very dark gray silty clay loam about 16 inches thick. The subsoil is very dark gray, dark gray, and gray, firm silty clay about 32 inches thick. It is calcareous in the lower part. The underlying material to a depth of 60 inches is light gray, mottled, calcareous silty clay loam. In some areas the soil has a light gray subsurface layer. In other areas it is calcareous throughout.

Included with this soil in mapping are small areas of Chancellor, Crossplain, Davison, and Wakonda soils. These soils make up less than 10 percent of any one mapped area. The somewhat poorly drained Chancellor and Crossplain soils are in swales and shallow drainageways. The moderately well drained Davison and Wakonda soils have a high content of lime within a depth of 16 inches. They are on slight rises above the Worthing soil.

The content of organic matter and fertility are high in the Worthing soil. Permeability is slow. Available water capacity is high. A seasonal high water table is within a depth of 1 foot part of the year. As much as 1 foot of water ponds on the surface during some wet periods. Runoff is ponded. The shrink-swell potential is high.

Most of the acreage supports native grasses. This soil is fairly well suited to range. The native vegetation dominantly is rivergrass, slough sedge, and reedgrass. Overused areas are dominated by spikesedge and unpalatable grasses and weeds. Many areas are potential sites for excavated ponds.

This soil generally is unsuited to cultivated crops and to windbreaks and environmental plantings and is fairly well suited to tame pasture and hay. Because the soil is frequently ponded, the number of suitable crops and pasture plants is severely limited. Garrison creeping foxtail and reed canarygrass are the best suited pasture plants.

This soil generally is unsuitable as a site for buildings and septic tank absorption fields because of the ponding.

The capability unit is Vw-2; Shallow Marsh range site.

prime farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in providing the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those uses. The soil qualities, growing season, and moisture supply are those

needed for a well managed soil economically to produce a sustained high yield of crops.

Prime farmland has an adequate and dependable supply of moisture. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. Some soils that have a high water table or are flooded qualify for prime farmland only in areas where these limitations have been overcome. Onsite evaluation is needed to determine whether or not the limitations have been overcome. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 303,030 acres in Turner County, or nearly 77 percent of the total acreage, meets the requirements for prime farmland. This land occurs throughout the county. The main crops are corn, soybeans, oats, and alfalfa.

The map units that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described in the section "Detailed soil map units."

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for the arable soils.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 83 percent of the acreage in Turner County is used for cultivated crops or for tame pasture and hay (*3*). The major crops are alfalfa, corn, oats, and soybeans. Barley, grain sorghum, and wheat also are grown. Alfalfa is harvested mainly for hay, and corn and oats are harvested for both silage and grain.

The potential of the soils in Turner County for increased crop production is good. In addition to the reserve productive capacity represented by this land, food production could also be increased considerably by extending the latest crop production technology to all cropland in the county. This soil survey can greatly facilitate the application of such technology. The paragraphs that follow describe the management needed on the cropland in the county.

Soil erosion is the major problem on about 43 percent of the cropland, hayland, and pasture in Turner County. If the slope is more than 2 percent, water erosion is a hazard on Clarno, Delmont, Egan, Ethan, Wentworth, and other soils. Blendon and Henkin soils also are subject to wind erosion.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into a plow layer. Loss of the surface layer is especially damaging on soils having a thin surface layer, such as Betts and Ethan. Erosion also reduces the productivity on soils that tend to be droughty, such as Delmont and Enet. Second, erosion results in the sedimentation of streams and lakes. Controlling erosion minimizes the pollution of streams and lakes by sediment and improves water quality for fish and wildlife, recreation, and municipal use.

A cropping system that includes grasses and legumes and that keeps a plant cover on the surface for extended periods holds soil losses to an amount that will not reduce the productive capacity of the soils. Leaving crop residue on the surface during the critical erosion period early in spring helps to protect the soil from wind and water erosion. The crop residue also adds organic

matter to the soil, improves fertility and tilth, and aids in the retention and absorption of rainfall.

Terraces, diversions, and contour stripcropping help to control erosion on some of the gently sloping to rolling soils. In some areas, however, slopes are so short and irregular that contour farming and terracing are not practical. In these areas a cropping system that keeps a substantial plant cover on the surface is needed to control erosion.

Minimizing tillage and leaving crop residue on the surface increase the infiltration rate and reduce the risks of runoff and erosion. Together with grassed waterways, these practices are suitable on most soils in the county.

Wind erosion is a slight to severe hazard on some of the soils in the county. The hazard is especially severe on those soils having a fine sandy loam surface layer, such as Blendon and Henkin. The soils that have a high content of lime in the surface layer, such as Davison and Wakonda, also are susceptible to wind erosion. These soils can be damaged in a few hours if winds are strong and the soils are dry and have no plant cover or surface mulch. An adequate plant cover, a cover of crop residue, stripcropping, and a rough surface minimize wind erosion on these soils. Including grasses and legumes in the cropping system, planting windbreaks of suited trees and shrubs, and leaving strips of unharvested crops also are effective in reducing the risk of wind erosion.

Information about the measures that control erosion on each kind of soil is contained in the Technical Guide, available in local offices of the Soil Conservation Service.

Soil drainage is the major management need on the wetter soils, such as the poorly drained Clamo and Tetonka and somewhat poorly drained Lamo soils. Unless artifically drained, these soils are so wet that crops frequently are damaged. Open ditches help to remove excess water if outlets are available. Controlling the runoff on the adjacent slopes also helps to reduce the wetness of these soils.

The moderately well drained Alcester, Bonilla, and Trent soils in swales receive runoff from adjacent uplands. In most years, drainage is adequate and crops benefit from the additional moisture. Artificial drainage is rarely needed on these soils. During wet years, however, spring planting and tillage are delayed.

Soil fertility should be maintained so that optimum yields can be obtained. In soils that have a high content of lime in the surface layer, such as Davison, Ethan, and Wakonda, the kinds and amounts of fertilizer needed generally differ from the kinds and amounts needed on soils that do not have lime in the surface layer. Including grasses and legumes in the cropping system improves fertility in the soils having a high content of lime. On all soils additions of fertilizer should be based on the results of soil tests, on the need of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer needed.

Soil tilth affects the germination of seeds and the infiltration of water into the soil. Soils with good tilth are granular and porous. If tilled when wet, Clamo, Crossplain, and similar soils tend to be very cloddy when dry. As a result of the cloddiness, preparing a good seedbed is difficult. These soils dry slowly in the spring and cannot be easily tilled. Selecting a proper time for tillage, including grasses and legumes in the cropping system, and incorporating crop residue into the soil improve tilth and increase the rate of water intake.

Field crops suited to the soils and climate of the survey area include small grain and row crops. Oats is the main small grain crop. Corn and soybeans are the main row crops. Sorghum also is grown on a small acreage.

All commonly grown and climatically adapted crops are suited to deep, well drained or moderately well drained soils, such as Alcester, Bonilla, Clarno, Davis, Egan, Roxbury, Trent, and Wentworth. Soils that are underlain by porous material, such as Delmont, Dempster, and Enet, are better suited to early maturing small grain than to deeper rooted crops, such as corn and alfalfa, because the porous underlying material limits the available water capacity and root penetration. Blendon and Henkin soils, which are subject to wind erosion, also are better suited to small grain than to row crops. The small grain provides better protection against wind erosion.

Much of the acreage of the Delmont and Enet soils is irrigated. Alfalfa and corn are the main irrigated crops. The main management concerns are preserving water quality, conserving moisture, and improving fertility and tilth. Nearly all of the irrigation is by sprinkler method. Water is pumped from a shallow aquifer that underlies most of the irrigated soils.

Pasture plants best suited to the climate and most of the soils in the survey area include alfalfa, intermediate wheatgrass, and smooth bromegrass. Crested wheatgrass is well suited to soils that tend to be droughty, such as Delmont and Enet. Bunch grasses, such as crested wheatgrass, should not be planted in areas where the slope is more than 6 percent because erosion is a hazard. The choice of pasture plants generally is limited to water tolerant species, such as Garrison creeping foxtail and reed canarygrass, on the poorly drained Clamo and Tetonka and very poorly drained Worthing soils.

Proper stocking rates, timely deferment of grazing, and applications of fertilizer help to keep the pasture in good condition. If the pasture is overgrazed, the grasses lose vigor and die and are usually replaced by annual grasses and weeds.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil listed for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit (*8*). These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6.

The capability classification of each map unit is given in the section "Detailed soil map units."

rangeland

About 11 percent of the acreage in Turner County is rangeland (*3*). Most of the rangeland occurs as small tracts throughout the county. The soils used as rangeland generally are too steep or too wet for cultivated crops. Examples are Baltic, Betts, and

Worthing soils and the steeper phases of the Ethan soils.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 7 shows, for some soils in the survey area, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to rangeland are listed. An explanation of the column headings in table 7 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of wind and water erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

The native vegetation in many parts of the county has been greatly depleted by continued excessive use. Much of the acreage that was once tall-grass prairie is now covered with inferior grasses and weeds. The amount of forage produced may be less than half of that originally produced. The productivity of the range can be increased by applying management that is effective on specific kinds of soil and range sites.

An adequate plant cover and ground mulch help to control erosion and increase the moisture supply by reducing the runoff rate. If the range is overgrazed, the more desirable tall grasses lose vigor and are replaced by less productive short grasses. Measures that prevent overgrazing help to keep the range in good condition. Crossfencing and properly distributed watering facilities help to obtain a uniform distribution of grazing.

native woods and windbreaks and environmental plantings

Native trees and shrubs grow on about 3,500 acres in Turner County. The soils that support trees are not classified as woodland soils. Most of the trees and shrubs grow on the breaks and flood plains adjacent to the East and West Forks of the Vermillion River, the Vermillion River, and Turkey Ridge Creek. Most are used to enhance the habitat for wildlife.

Isolated trees or shrubs, small clumps, or large groves of American elm, American plum, boxelder, bur oak, eastern redcedar, green ash, western snowberry, and wild rose are common on Betts and Ethan soils in draws on breaks adjacent to the major creeks and rivers. Isolated trees or shrubs or small clumps of American elm, American plum, boxelder, common chokecherry, eastern cottonwood, false indigo, green ash, peachleaf willow, riverbank grape, sandbar willow, western snowberry, and wild rose are common on Chaska, Clamo, Lamo, and Roxbury soils on the flood plains along the major creeks and rivers. Isolated trees or shrubs or clumps of eastern cottonwood, peachleaf willow, and sandbar willow are at the margins of marshy areas.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, keep snow from blowing off the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. The species listed in table 8 are only a partial list of those that will grow on the soils. A more complete list is in the Technical Guide in the local office of the Soil Conservation Service.

Grazing is detrimental to windbreaks and environmental plantings because the livestock compact the soil and remove the lower branches of the trees and shrubs. Removal of the lower branches reduces the effectiveness of the windbreaks. Weeds and insects prevent maximum growth. Clean cultivation and applications of herbicide help to control weeds. Fallowing a year before planting helps to provide a reserve supply of moisture, which is needed before seedlings can be established. On Blendon and other soils that are susceptible to wind erosion, the site should be prepared in the spring so that it is not exposed to wind erosion during the winter.

Additional information about planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

wildlife habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are barley, corn, oats, sorghum, and wheat.

Grasses and legumes are domestic biennial and perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are alfalfa, intermediate wheatgrass, reed canarygrass, smooth bromegrass, sweetclover, and tall wheatgrass.

Wild herbaceous plants are native grasses and forbs. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are big bluestem, Maximilian sunflower, switchgrass, tansymustard, and western wheatgrass.

Hardwood trees are planted trees and shrubs that produce nuts or other fruit, buds, catkins, twigs, bark,

and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are bur oak, crabapple, green ash, hackberry, peachleaf willow, plains cottonwood, and Russian-olive. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are American plum, chokecherry, cotoneaster, and honeysuckle.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are Black Hills spruce, eastern redcedar, ponderosa pine, and Rocky Mountain juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are broadleaf cattail, common reed, common spikesedge, giant burreed, hardstem bulrush, prairie cordgrass, and slough sedge.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, ponds, and waterfowl feeding areas.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, trees, and shrubs. These areas produce grain and seed crops, grasses and legumes, and wild woody and herbaceous plants. The wildlife attracted to these areas include bobwhite, eastern cottontail, eastern meadowlark, field sparrow, gray partridge, red fox, and ring-necked pheasant.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include bluejay, eastern fox squirrel, raccoon, red fox, robin, whitetail deer, and yellow-shafted flicker.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are American avocet, blue-winged teal, killdeer, lesser scaup, mallard, mink, muskrat, pintail, and redhead.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include eastern cottontail, eastern meadowlark, lark bunting, whitetail deer, whitetail jackrabbit, and Richardson ground squirrel.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water

conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

sanitary facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, and flooding affect absorption of the effluent.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons (aerobic) are shallow ponds constructed to hold sewage while aerobic bacteria

decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, flooding, stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to

the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Acidity and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by stones, slope, and the hazard of cutbanks caving. The productivity of the

soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope and wetness affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Wetness and slope affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances, such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 or 20 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 17.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

physical and chemical properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.10 to 0.43. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can

be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 3 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

engineering index test data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series. The soil samples were analyzed by the South Dakota Department of Transportation, Division of Highways.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*9*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 18, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning intermittent dryness, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplustolls (*Hapl*, meaning minimal horizonation, plus *ustoll*, the suborder of the Mollisols that have an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, mesic Typic Haplustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*7*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*9*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Alcester series

The Alcester series consists of deep, moderately well drained soils formed in silty material on foot slopes and alluvial fans. Permeability is moderate. Slopes range from 0 to 2 percent.

Alcester soils are similar to Bonilla, Davis, Roxbury, and Trent soils and are near Davis, Egan, Roxbury, and Wentworth soils. Bonilla and Davis soils contain more sand throughout than the Alcester soils. Roxbury soils are calcareous closer to the surface than the Alcester soils. They are on flood plains. The well drained Egan and Wentworth soils have a mollic epipedon that is less

than 20 inches thick. They are higher on the landscape than the Alcester soils. The content of organic matter in Trent soils regularly decreases with increasing depth.

Typical pedon of Alcester silt loam, 1,938 feet north and 66 feet east of the southwest corner of sec. 33, T. 96 N., R. 52 W.

Ap—0 to 10 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A12—10 to 17 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; gradual wavy boundary.

B1—17 to 24 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; slightly acid; gradual wavy boundary.

B2—24 to 38 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; very dark brown (10YR 2/2) coatings on faces of peds; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; slightly acid; gradual wavy boundary.

B3—38 to 46 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; dark brown (10YR 3/3) coatings on faces of peds; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; slightly acid; gradual wavy boundary.

C1—46 to 54 inches; light yellowish brown (2.5Y 6/3) silty clay loam, olive brown (2.5Y 4/3) moist; massive; hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

C2—54 to 60 inches; light yellowish brown (2.5Y 6/3) silt loam, light olive brown (2.5Y 5/3) moist; massive; slightly hard, friable; weak effervescence; mildly alkaline.

The thickness of the solum ranges from 36 to 56 inches. The depth to free carbonates ranges from 36 to 60 inches. The thickness of the mollic epipedon ranges from 24 to 50 inches. The texture is silt loam or silty clay loam throughout the profile.

The A horizon has value of 3 or 4 (2 or 3 moist). It ranges from neutral to medium acid. The B2 horizon has hue of 10YR or 2.5Y, value of 4 or 5 (2 to 4 moist), and chroma of 1 to 3. It is neutral or slightly acid. The C horizon has hue of 10YR or 2.5Y, value of 6 (4 or 5 moist), and chroma of 2 or 3. It ranges from neutral to moderately alkaline.

Arlo series

The Arlo series consists of poorly drained soils that are moderately deep over gravelly and sandy material. These soils formed in glacial outwash material on flood plains. Permeability is moderate in the loamy sediments and rapid in the underlying material. Slopes range from 0 to 2 percent.

Arlo soils are near Baltic, Clamo, Delmont, Dimo, and Enet soils. The nearby soils do not have a calcic horizon. They are higher on the landscape than the Arlo soils. Baltic and Clamo soils do not have sand and gravel within a depth of 40 inches. The somewhat excessively drained Delmont soils and the well drained Enet soils do not have a water table within a depth of 5 feet.

Typical pedon of Arlo clay loam, 1,720 feet south and 75 feet east of the northwest corner of sec. 5, T. 97 N., R. 52 W.

Ap—0 to 11 inches; dark gray (10YR 4/1) clay loam, black (10YR 2/1) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence (about 11 percent calcium carbonate); mildly alkaline; abrupt smooth boundary.

ACca—11 to 18 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to weak fine and medium granular; slightly hard, friable; violent effervescence (about 20 percent calcium carbonate); moderately alkaline; gradual wavy boundary.

C1ca—18 to 31 inches; light gray (10YR 7/1) sandy clay loam, gray (10YR 5/1) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; violent effervescence (about 24 percent calcium carbonate); moderately alkaline; gradual wavy boundary.

C2ca—31 to 35 inches; light brownish gray (2.5Y 6/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; common fine faint gray (10YR 5/1) and distinct light olive brown (2.5Y 5/6) mottles; massive; soft, very friable, slightly sticky and slightly plastic; few fine dark concretions (iron and manganese oxide); many coarse accumulations of carbonate; strong effervescence (about 12 percent calcium carbonate); moderately alkaline; clear smooth boundary.

IIC3—35 to 50 inches; light olive brown (2.5Y 5/4) gravelly sand, olive brown (2.5Y 4/4) moist; common fine and medium distinct dark brown (7.5YR 3/2) and yellowish brown (10YR 5/6) mottles; single grain; loose; common fine dark concretions (iron and manganese oxide); strong effervescence (about 7 percent calcium carbonate); moderately alkaline; gradual wavy boundary.

IIC4—50 to 60 inches; light gray (2.5Y 7/2) loamy sand, light brownish gray (2.5Y 6/2) moist; common fine and medium prominent yellowish brown (10YR 5/6) mottles; single grain; loose; few pebbles; common shale chips; few fine dark concretions (iron and manganese oxide); sand grains coated with calcium carbonate; strong effervescence (about 6 percent calcium carbonate); moderately alkaline.

The depth to gravelly sand ranges from 20 to 40 inches. The thickness of the mollic epipedon ranges from 12 to 20 inches and corresponds to the thickness of the solum. The soils contain free carbonates throughout.

The A horizon has value of 3 to 5 (2 or 3 moist). It typically is clay loam but in some pedons is loam. It ranges from neutral to moderately alkaline. The Cca horizon has hue of 10YR, 2.5Y, or 5Y and value of 5 to 7 (4 to 6 moist). It dominantly is loam, sandy clay loam, or clay loam but in some pedons is sandy loam in the lower part. It is mildly alkaline or moderately alkaline. Few or common nests of gypsum are in some pedons. The IIC horizon has hue of 10YR, 2.5Y, or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 to 4. It is stratified gravelly loamy sand, gravelly sand, sand, or loamy sand. It is mildly alkaline or moderately alkaline.

Baltic series

The Baltic series consists of deep, very poorly drained, slowly permeable soils formed in calcareous, silty and clayey alluvium on flood plains and in depressions on uplands. Slopes are less than 1 percent.

Baltic soils are similar to Tetonka and Worthing soils and are near Davison, Lamo, Salmo, and Wakonda soils. The moderately well drained Davison and Wakonda soils have a calcic horizon. They are on slight rises. The somewhat poorly drained Lamo soils contain less clay than the Baltic soils. Salmo soils also contain less clay and have visible salts at or near the surface. Tetonka soils have a light gray subsurface layer. Worthing soils are deeper to carbonates than the Baltic soils.

Typical pedon of Baltic silty clay loam, 1,700 feet west and 80 feet north of the southeast corner of sec. 15, T. 100 N., R. 52 W.

A1—0 to 12 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak medium and fine subangular blocky structure; hard, firm, slightly sticky and slightly plastic; slight effervescence; mildly alkaline; abrupt smooth boundary.

B21g—12 to 24 inches; very dark gray (5Y 3/1) silty clay, black (5Y 2/1) moist; weak coarse and medium subangular blocky structure; very hard, firm, sticky and plastic; few fine accumulations of carbonate; slight effervescence; mildly alkaline; gradual wavy boundary.

B22g—24 to 32 inches; very dark gray (5Y 3/1) silty clay, black (5Y 2/1) moist; weak coarse and medium subangular blocky structure; very hard, firm, sticky and plastic; common gypsum crystals; nests of gypsum; few fine accumulations of carbonate; slight effervescence; mildly alkaline; gradual wavy boundary.

C1gcs—32 to 49 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; few fine distinct light olive brown (2.5Y 5/6) mottles; massive; very hard, firm, sticky and plastic; many fine and medium nests of gypsum; slight effervescence; mildly alkaline; gradual wavy boundary.

C2g—49 to 60 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; few fine distinct light olive brown (2.5Y 5/6) mottles; massive; very hard, firm, sticky and plastic; few gypsum crystals; common fine accumulations of carbonate; strong effervescence; mildly alkaline.

The thickness of the solum and the thickness of the mollic epipedon range from 30 to 45 inches. The soils contain free carbonates throughout and are mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR or 5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or less. It typically is silty clay loam but in some pedons is silty clay. The B2g horizon has hue of 5Y or is neutral in hue. It has value of 3 to 5 (2 or 3 moist) and chroma of 1 or less. It typically is silty clay but in some pedons is clay or silty clay loam. The Cg horizon has hue of 2.5Y or 5Y and value of 4 to 7 (3 to 6 moist). It is silty clay loam, silty clay, or clay loam.

Betts series

The Betts series consists of deep, well drained soils formed in loamy glacial till on uplands. Permeability is moderate in the solum and moderately slow in the underlying material. Slopes range from 6 to 40 percent.

Betts soils are similar to Ethan soils and are near Clarno, Ethan, and Talmo soils. The nearby soils have a mollic epipedon. Clarno soils are less sloping than the Betts soils. Talmo soils have gravelly material within a depth of 14 inches. They are on knolls.

Typical pedon of Betts loam, in an area of Betts-Ethan loams, 15 to 40 percent slopes, 325 feet south and 1,800 feet west of the northeast corner of sec. 17, T. 100 N., R. 53 W.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; strong effervescence; mildly alkaline; gradual smooth boundary.

ACca—4 to 9 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few pebbles; common fine accumulations of carbonate; violent effervescence; mildly alkaline; gradual wavy boundary.

C1ca—9 to 26 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct olive yellow (2.5Y 6/6) mottles; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few pebbles; common fine accumulations of carbonate; violent effervescence; mildly alkaline; gradual wavy boundary.

C2—26 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct yellowish brown (10YR 5/8) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; strong effervescence; mildly alkaline.

The solum is less than 10 inches thick. Free carbonates are within a depth of 3 inches. The clay content of the control section averages as low as 25 percent in some pedons and as high as 35 percent in others.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is neutral or mildly alkaline. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. It is clay loam or loam. It is mildly alkaline or moderately alkaline. The mottles in this horizon are inherited from the parent material.

Blendon series

The Blendon series consists of deep, well drained soils formed in loamy and sandy alluvium on terraces. Permeability is moderate or moderately rapid in the upper part of the profile and moderately rapid or rapid in the lower part. Slopes range from 0 to 6 percent.

Blendon soils are similar to Henkin soils and are near Davis, Delmont, Dempster, Enet, and Henkin soils. Davis, Delmont, Dempster, and Enet soils contain more clay in the subsoil than the Blendon soils. They are in positions on the landscape similar to those of the Blendon soils. Also, Delmont, Dempster, and Enet soils are underlain by gravelly material. Henkin soils have a mollic epipedon that is less than 20 inches thick.

Typical pedon of Blendon fine sandy loam, in an area of Blendon-Henkin fine sandy loams, 2 to 6 percent slopes, 85 feet east and 240 feet north of the center of sec. 35, T. 96 N., R. 52 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; medium acid; abrupt smooth boundary.

B2—8 to 26 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky, soft, very friable; slightly acid; gradual wavy boundary.

B3—26 to 36 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; soft, very friable; neutral; clear wavy boundary.

C1—36 to 54 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; massive; soft, very friable; neutral; clear wavy boundary.

C2—54 to 60 inches; very pale brown (10YR 7/3) loamy sand, brown (10YR 5/3) moist; massive; soft, very friable; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 24 to 45 inches. The depth to free carbonates ranges from 40 to more than 60 inches. The thickness of the mollic epipedon ranges from 20 to 45 inches. The clay content of the control section averages as low as 10 percent in some pedons and as high as 18 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It typically is fine sandy loam but in some pedons is loam. It ranges from medium acid to neutral. The B2 horizon has value of 3 or 4 (2 or 3 moist). It is fine sandy loam or sandy loam. It is slightly acid or neutral. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (3 to 5 moist), and chroma of 2 to 4. It is loamy sand, loamy fine sand, fine sandy loam, or sandy loam. It ranges from neutral to moderately alkaline.

Bonilla series

The Bonilla series consists of deep, moderately well drained soils formed in loamy glacial till in swales on uplands. Permeability is moderate in the solum and moderately slow in the underlying material. Slopes range from 0 to 2 percent.

Bonilla soils are similar to Alcester, Davis, and Trent soils and are near Clarno, Crossplain, Ethan, and Tetonka soils. The subsoil of Alcester and Trent soils contains less sand than that of the Bonilla soils. The well drained Clarno and Ethan soils have a mollic epipedon that is less than 20 inches thick. They are higher on the landscape than the Bonilla soils. The somewhat poorly drained Crossplain soils are in positions on the landscape similar to those of the Bonilla soils. The well drained Davis soils formed in alluvium on foot slopes and stream terraces. The poorly drained Tetonka soils are in depressions.

Typical pedon of Bonilla loam, in an area of Clarno-Bonilla loams, 1 to 6 percent slopes (fig.9), 1,420 feet north and 115 feet west of the southeast corner of sec. 5, T. 98 N., R. 54 W.

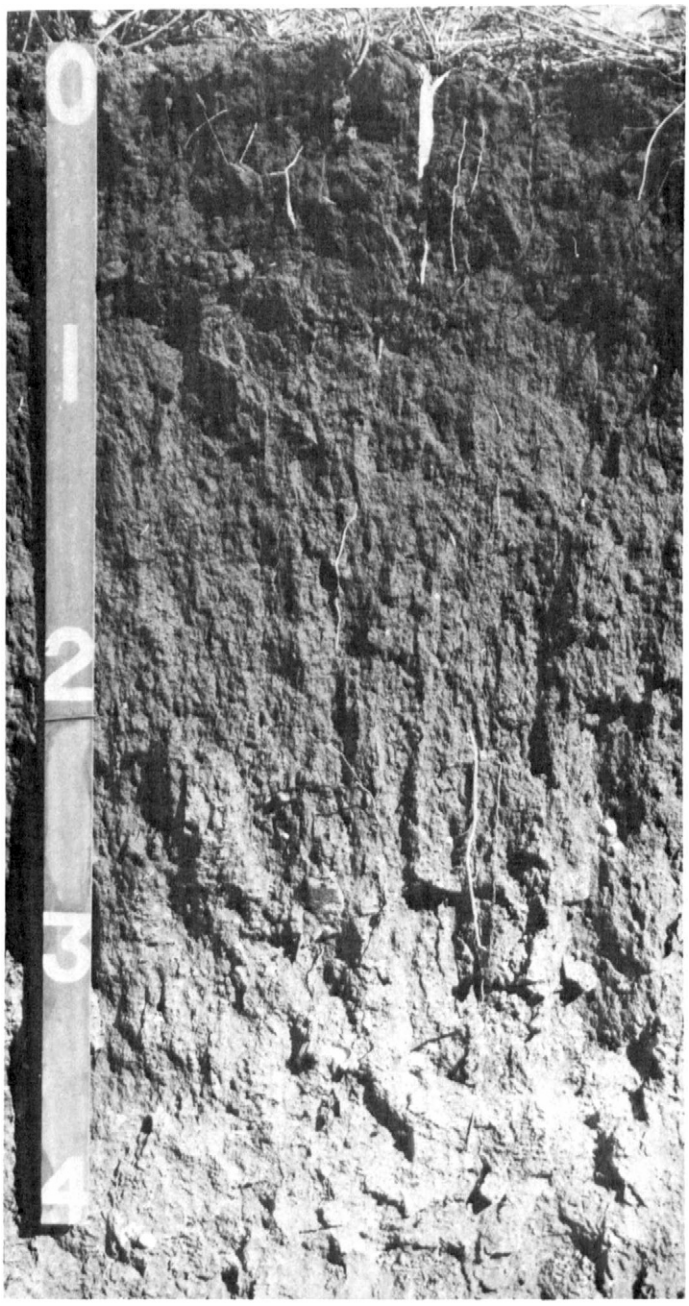

Figure. 9.—Profile of Bonilla loam. Dark colors extend to a depth of about 26 inches. Depth is marked in feet.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; medium acid; abrupt smooth boundary.

A12—8 to 13 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; medium acid; clear wavy boundary.

B21—13 to 29 inches; dark gray (10YR 4/1) clay loam, very dark brown (10YR 2/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; slightly acid; gradual wavy boundary.

B22—29 to 35 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct yellowish brown (10YR 5/6) and black (10YR 2/1) mottles; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

B3ca—35 to 42 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct yellowish brown (10YR 5/6) and very dark brown (10YR 2/2) mottles; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C1ca—42 to 47 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common fine distinct light olive brown (2.5Y 5/6) and gray (2.5Y 6/1) mottles; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine and medium accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—47 to 60 inches; light yellowish brown (2.5Y 6/4) and light gray (5Y 7/1) clay loam, olive brown (2.5Y 4/4) and gray (5Y 5/1) moist; few fine distinct very dark brown (10YR 2/2) mottles; massive; hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 30 to 47 inches. The depth to free carbonates and the thickness of the mollic epipedon range from 20 to 40 inches.

The A horizon has value of 3 or 4 (2 or 3 moist). It typically is loam but in some pedons is silt loam. It ranges from medium acid to neutral. The B2 horizon has value of 4 or 5 (2 to 4 moist) and chroma of 1 or 2. It typically is clay loam but in some pedons is loam. It is slightly acid or neutral. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 6 or 7 (4 or 5 moist), and chroma of 1 to 4. It dominantly is clay loam but in some pedons is loam. It is mildly alkaline or moderately alkaline.

Chancellor series

The Chancellor series consists of deep, somewhat poorly drained soils formed in a thin mantle of local silty and clayey alluvium over silty glacial drift. These soils are in swales and shallow drainageways on uplands. Permeability is slow. Slopes range from 0 to 2 percent.

Chancellor soils are similar to Clamo and Crossplain soils and are near Egan, Tetonka, Wakonda, Wentworth, and Worthing soils. The poorly drained Clamo soils are on flood plains. Crossplain soils contain more sand throughout than the Chancellor soils. The well drained Egan and Wentworth soils are higher on the landscape than the Chancellor soils. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions. The moderately well drained Wakonda soils have a calcic horizon. They are on slight rises above the Chancellor soils.

Typical pedon of Chancellor silty clay loam, in an area of Wentworth-Chancellor-Wakonda silty clay loams, 0 to 2 percent slopes, 1,320 feet east and 1,070 feet north of the southwest corner of sec. 15, T. 97 N., R. 52 W.

Ap—0 to 11 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine subangular blocky structure parting to weak fine granular; hard, friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

B21—11 to 23 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; weak medium prismatic structure parting to weak medium subangular blocky; very hard, firm, sticky and plastic; neutral; gradual wavy boundary.

B22tg—23 to 28 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; common fine distinct light olive brown (2.5Y 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; black (5Y 2/1) coatings on faces of peds; neutral; gradual wavy boundary.

B3—28 to 36 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct light olive brown (2.5Y 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; mildly alkaline; clear wavy boundary.

C1ca—36 to 46 inches; light yellowish brown (2.5Y 6/4) silty clay loam, olive brown (2.5Y 4/4) moist; common fine distinct dark yellowish brown (10YR 4/6) and gray (5Y 6/1) mottles; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine dark concretions (iron and manganese oxide); strong effervescence; moderately alkaline; gradual wavy boundary.

C2cacs—46 to 54 inches; light yellowish brown (2.5Y 6/4) silty clay loam, light olive brown (2.5Y 5/4) moist; many fine and medium distinct dark yellowish brown (10YR 4/6) and gray (5Y 6/1) mottles; massive; hard, friable, slightly sticky and slightly plastic; few fine dark concretions (iron and manganese oxide); common fine and medium nests of gypsum; few fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C3—54 to 60 inches; light gray (2.5Y 7/2) silty clay loam, light olive gray (5Y 6/2) moist; many fine and medium distinct strong brown (7.5YR 5/8), light olive brown (2.5Y 5/6), and black (10YR 2/1) mottles; massive; hard, friable, slightly sticky and slightly plastic; few fine dark concretions (iron and manganese oxide); few fine nests of gypsum; few fine accumulations of carbonate; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 28 to 44 inches. The thickness of the mollic epipedon ranges from 24 to 40 inches. The clay content of the argillic horizon averages as low as 38 percent in some pedons and as high as 50 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist). It is slightly acid or neutral. The B2t horizon has value of 3 to 5 (2 to 4 moist). It typically is silty clay but in some pedons is silty clay loam. It ranges from slightly acid to mildly alkaline. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is silty clay loam or clay loam. It is mildly alkaline or moderately alkaline. In some pedons it does not have accumulations of gypsum.

Chaska series

The Chaska series consists of deep, somewhat poorly drained soils formed in stratified loamy alluvium. These soils are on flood plains that are dissected by meandering stream channels. Permeability is moderate. Slopes range from 0 to 2 percent.

Chaska soils are near Davis, Ethan, Lamo, and Roxbury soils. The well drained Davis and Roxbury soils are slightly higher on the flood plains than the Chaska soils. The well drained, moderately sloping to steep Ethan soils are on uplands. Lamo soils contain more silt and less sand throughout than the Chaska soils.

Typical pedon of Chaska loam, channeled, 340 feet south and 1,320 feet east of the northwest corner of sec. 13, T. 99 N., R. 54 W.

A1—0 to 9 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; mildly alkaline; clear smooth boundary.

C1—9 to 40 inches; dark gray (10YR 4/1) stratified silt loam and loam, very dark gray (10YR 3/1) moist; thin strata of light brownish gray (2.5Y 6/2) loamy fine sand, grayish brown (2.5Y 5/2) moist; massive; common fine distinct yellowish brown (10YR 5/6) mottles; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; mildly alkaline; clear smooth boundary.

C2g—40 to 60 inches; gray (5Y 5/1) stratified silt loam and loam, very dark gray (5Y 3/1) moist; common fine prominant yellowish brown (10YR 5/6) mottles; massive; hard, friable, slightly sticky and slightly plastic; few fine fragments of snail shells; few fine accumulations of carbonate; strong effervescence; moderately alkaline.

Free carbonates are within a depth of 10 inches. The clay content of the control section averages as low as 18 percent in some pedons and as high as 27 percent in others.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It typically is loam but in some pedons is silt loam, silty clay loam, or clay loam. It is neutral or mildly alkaline. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 4 to 6 (3 to 5 moist), and chroma of 1 to 3. It is stratified loam, silt loam, and fine sandy loam. It is mildly alkaline or moderately alkaline.

Clamo series

The Clamo series consists of deep, poorly drained soils formed in clayey and silty alluvium on flood plains. Permeability is slow. Slopes are less than 1 percent.

Clamo soils are similar to Chancellor and Crossplain soils and are near Chaska, Dimo, Lamo, Roxbury, and Roxbury Variant soils. The somewhat poorly drained Chancellor and Crossplain soils have an argillic horizon. They are in swales in the uplands. Chaska, Dimo, Lamo, and Roxbury soils contain less clay than the Clamo soils. The somewhat poorly drained Chaska soils are in drainageways. The somewhat poorly drained Dimo soils are underlain by sand and gravel at a depth of 20 to 40 inches. They are in positions on the landscape similar to those of the Clamo soils. The well drained Roxbury and moderately well drained Roxbury Variant soils are slightly higher on the landscape than the Clamo soils.

Typical pedon of Clamo silty clay, 1,495 feet south and 143 feet west of the northeast corner of sec. 33, T. 98 N., R. 52 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; weak fine and medium granular structure; hard, firm, sticky and plastic; slightly acid; abrupt smooth boundary.

A12—7 to 12 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; weak medium subangular blocky structure parting to moderate fine and medium granular; very hard, firm, sticky and plastic; slightly acid; clear wavy boundary.

B21g—12 to 23 inches; dark gray (5Y 4/1) silty clay, black (5Y 2/1) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; neutral; clear wavy boundary.

B22g—23 to 29 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; neutral; clear wavy boundary.

B3gca—29 to 39 inches; dark gray (5Y 4/1) silty clay loam, very dark gray (5Y 3/1) moist; few fine distinct yellowish brown (10YR 5/6) and black (10YR 2/1) mottles; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; common fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C1gca—39 to 46 inches; gray (5Y 5/1) silty clay loam, dark gray (5Y 4/1) moist; common fine distinct yellowish brown (10YR 5/6) mottles; massive; hard, firm, slightly sticky and slightly plastic; common fine dark concretions (iron and manganese oxide); many fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—46 to 60 inches; light olive gray (5Y 6/2) silty clay loam, olive gray (5Y 5/2) moist; common fine distinct yellowish brown (10YR 5/6) and very dark brown (10YR 2/2) mottles; massive; hard, friable, slightly sticky and slightly plastic; common fine dark concretions (iron and manganese oxide); common fine accumulations of carbonate; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 30 to 45 inches. The depth to free carbonates ranges from 15 to 30 inches. The thickness of the mollic epipedon ranges from 24 to 45 inches. The clay content of the control section averages as low as 35 percent in some pedons and as high as 50 percent in others. A buried A horizon is in some pedons.

The A horizon is neutral in hue or has hue of 10YR or 2.5Y. It has value of 3 or 4 (2 or 3 moist). It is silty clay or clay. It ranges from slightly acid to mildly alkaline. The B2g horizon is neutral in hue or has hue of 5Y. It has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is silty clay or clay. It is neutral or mildly alkaline. The C horizon is neutral in hue or has hue of 2.5Y or 5Y. It has value of 4 to 6 (3 to 5 moist) and chroma of 1 or 2. It is mildly alkaline or moderately alkaline. It is silty clay loam, silty clay, clay loam, or sandy clay loam. In some pedons

gravelly loamy sand or gravelly sand is at a depth of 40 to 60 inches.

Clarno series

The Clarno series consists of deep, well drained and moderately well drained soils formed in loamy glacial till on uplands. Permeability is moderate in the subsoil and moderately slow in the underlying material. Slopes range from 0 to 9 percent.

Clarno soils are near Bonilla, Crossplain, Davison, Ethan, and Tetonka soils. Bonilla soils have a mollic epipedon that is more than 20 inches thick. They are in swales. The somewhat poorly drained Crossplain soils are in swales and drainageways. Davison soils have a calcic horizon. They are on slight rises above swales and depressions. Ethan soils have free carbonates at or near the surface. They are on knolls and the more sloping parts of the landscape. The poorly drained Tetonka soils are in depressions.

Typical pedon of Clarno loam, in an area of Clarno-Crossplain-Davison complex, 0 to 3 percent slopes, 620 feet south and 115 feet east of the northwest corner of sec. 32, T. 99 N., R. 54 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; abrupt smooth boundary.

B21—9 to 15 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; gradual wavy boundary.

B22—15 to 20 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak medium and fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline; clear wavy boundary.

B3ca—20 to 30 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C1ca—30 to 40 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; common fine distinct light olive brown (2.5Y 5/6) mottles; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—40 to 60 inches; light gray (2.5Y 7/2) and light yellowish brown (2.5Y 6/4) clay loam, light brownish gray (2.5Y 6/2) and light olive brown (2.5Y 5/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 38 inches. The depth to free carbonates ranges from 12 to 26 inches. The thickness of the mollic epipedon ranges from 8 to 20 inches. The clay content of the control section averages as low as 25 percent in some pedons and as high as 30 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It typically is loam but in some pedons is silt loam. It is slightly acid or neutral. The B2 horizon has hue of 10YR or 2.5Y and value of 4 or 5 (2 to 4 moist). It is clay loam or loam. It is neutral or mildly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is clay loam or loam. It is mildly alkaline or moderately alkaline. Accumulations of gypsum crystals are below a depth of 40 inches in some pedons.

Crossplain series

The Crossplain series consists of deep, somewhat poorly drained soils formed in a thin mantle of local loamy and clayey alluvium over loamy glacial till. These soils are in swales and shallow drainageways on uplands. Permeability is slow. Slopes range from 0 to 2 percent.

Crossplain soils are similar to Chancellor and Clamo soils and are near Bonilla, Clarno, Davison, Tetonka, and Worthing soils. The moderately well drained Bonilla soils are in positions on the landscape similar to those of the Crossplain soils. Chancellor soils contain less sand throughout than the Crossplain soils. The poorly drained Clamo soils are on flood plains. The well drained and moderately well drained Clarno soils are higher on the landscape than the Crossplain soils. The moderately well drained Davison soils have a calcic horizon. They are on slight rises above the Crossplain soils. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions.

Typical pedon of Crossplain clay loam, in an area of Clarno-Crossplain-Davison complex, 0 to 3 percent slopes, 240 feet south and 2,400 feet west of the northeast corner of sec. 21, T. 100 N., R. 54 W.

Ap—0 to 9 inches; dark gray (10YR 4/1) clay loam, black (10YR 2/1) moist; weak medium granular structure; hard, friable, slightly sticky and slightly plastic; slightly acid; abrupt smooth boundary.

B21tg—9 to 19 inches; dark gray (5Y 4/1) clay, very dark gray (5Y 3/1) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; neutral; gradual wavy boundary.

B22tg—19 to 26 inches; gray (5Y 5/1) clay, very dark gray (5Y 3/1) moist; few fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium and fine subangular blocky; very hard, firm, sticky and plastic; neutral; clear wavy boundary.

B3ca—26 to 38 inches; light brownish gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/4) moist; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine nests of gypsum; few dark concretions (iron and manganese oxide); common fine accumulations of carbonate; strong effervescence; neutral; gradual wavy boundary.

C1cacs—38 to 46 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; common fine and medium distinct brownish yellow (10YR 6/6) mottles; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium nests of gypsum; common fine dark concretions (iron and manganese oxide); common fine accumulations of carbonate; strong effervescence; mildly alkaline; clear wavy boundary.

C2—46 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; common fine and medium distinct yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine dark concretions (iron and manganese oxide); few fine accumulations of carbonate; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 25 to 40 inches. The depth to free carbonates ranges from 20 to 44 inches. The thickness of the mollic epipedon ranges from 20 to 36 inches. The clay content of the control section averages as low as 35 percent in some pedons and as high as 45 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or less. It typically is clay loam but in some pedons is loam. It is slightly acid or neutral. The B2tg horizon has value of 3 to 5 (2 to 4 moist) and chroma of 1 or 2. It is clay or clay loam. It is slightly acid or neutral. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6 (4 or 5 moist), and chroma of 1 to 4. It is clay loam or loam. It ranges from neutral to moderately alkaline.

Davis series

The Davis series consists of deep, well drained soils formed in loamy and silty alluvium on foot slopes, fans, flood plains, and low terraces. Permeability is moderate. Slopes range from 0 to 6 percent.

Davis soils are similar to Alcester, Bonilla, Graceville, and Roxbury soils and are near Alcester, Chaska, Clamo, Ethan, and Roxbury soils. Alcester soils contain less sand throughout than the Davis soils. The moderately well drained Bonilla soils are in swales on uplands. The somewhat poorly drained Chaska soils are in narrow drainageways. The poorly drained Clamo soils contain more clay throughout than the Davis soils. Ethan soils have a mollic epipedon that is less than 10 inches thick. They are on uplands. Graceville soils are underlain by gravelly material at a depth of 40 to 60 inches. Roxbury soils contain less sand than the Davis soils and have free carbonates within 15 inches of the surface.

Typical pedon of Davis loam, 2 to 6 percent slopes, 2,062 feet east and 80 feet south of the northwest corner of sec. 7, T. 100 N., R. 53 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; abrupt smooth boundary.

A12—9 to 14 inches; very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; clear smooth boundary.

B21—14 to 29 inches; very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

B22—29 to 40 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

B3ca—40 to 48 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; slight effervescence; neutral; gradual wavy boundary.

Cca—48 to 60 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 60 inches. The thickness of the mollic epipedon and the depth to free carbonates range from 20 to 50 inches. The clay content of the control section averages as low as 18 percent in some pedons and as high as 30 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It is loam or silt loam. It is slightly acid or neutral. The B2 horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 to 4 moist), and chroma of 1 or 2. It is loam, silt loam, or clay loam. It is slightly acid or neutral. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 1 or 2. It is mildly alkaline or moderately alkaline. It dominantly is loam or silt loam. In some pedons, however, it is stratified with fine sandy loam or clay loam, and in others gravelly loamy sand, gravelly sand, loamy sand, and sand are at a depth of 40 to 60 inches.

Davis loam, sandy substratum, 0 to 2 percent slopes, is a taxadjunct to the Davis series because it is underlain by gravelly material at a depth of 30 to 40 inches. This difference, however, does not greatly alter the use or behavior of the soil.

Davison series

The Davison series consists of deep, moderately well drained soils formed in loamy glacial till. These soils are on low rises above swales and depressions on uplands. Permeability is moderate in the solum and moderately slow in the underlying material. Slopes range from 0 to 5 percent.

Davison soils are similar to Wakonda soils and are near Clarno, Crossplain, Tetonka, and Worthing soils. The nearby soils do not have a calcic horizon. The well drained and moderately well drained Clarno soils are on side slopes. The somewhat poorly drained Crossplain soils are in swales and drainageways. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions. Wakonda soils contain less sand throughout than the Davison soils.

Typical pedon of Davison loam, in an area of Clarno-Crossplain-Davison complex, 0 to 3 percent slopes, 1,630 feet north and 400 feet east of the southwest corner of sec. 18, T. 100 N., R. 55 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; (about 8 percent calcium carbonate); mildly alkaline; abrupt smooth boundary.

ACca—10 to 14 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; violent effervescence (about 18 percent calcium carbonate); moderately alkaline; gradual wavy boundary.

C1ca—14 to 25 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many medium accumualtions of carbonate; violent effervescence (about 23 percent calcium carbonate); moderately alkaline; gradual wavy boundary.

C2—25 to 36 inches; light yellowish brown (2.5Y 6/3) clay loam, dark olive brown (2.5Y 4/3) moist; few fine faint yellowish brown (10YR 5/4) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; strong effervescence (about 14 percent calcium carbonate); moderately alkaline; gradual wavy boundary.

C3cs—36 to 48 inches; light yellowish brown (2.5Y 6/4) clay loam, olive brown (2.5Y 4/4) moist; common fine distinct brownish yellow (10YR 6/6) and grayish brown (10YR 5/2) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common medium nests of gypsum; few fine accumulations of carbonate; strong effervescence (about 10 percent calcium carbonate); mildly alkaline; gradual wavy boundary.

C4—48 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; common medium distinct brownish yellow (10YR 6/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine nests of gypsum; common medium dark stains (iron and manganese oxide); strong effervescence (about 10 percent calcium carbonate); mildly alkaline.

The depth to free carbonates is less than 6 inches. The thickness of the mollic epipedon ranges from 7 to 15 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It typically is loam but in some pedons is silt loam. It ranges from neutral to moderately alkaline. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 to 4. It is clay loam or loam. It is mildly alkaline or moderately alkaline.

Delmont series

The Delmont series consists of somewhat excessively drained soils that are shallow over gravelly sand. These soils formed in loamy alluvium over gravelly sand. They

are on terraces. Permeability is moderate in the solum and rapid in the underlying material. Slopes range from 0 to 6 percent.

Delmont soils are similar to Enet soils and are near Baltic, Blendon, Dempster, Dimo, Enet, and Talmo soils. The very poorly drained Baltic soils are in depressions. Blendon soils contain less clay in the subsoil than the Delmont soils and are not underlain by gravelly material. They are in positions on the landscape similar to those of the Blendon soils. Dempster and Enet soils are more than 20 inches deep over gravelly material. They are lower on the landscape than the Delmont soils. The somewhat poorly drained Dimo soils are in swales. Talmo soils have gravelly material within a depth of 14 inches. They are on knolls and ridges.

Typical pedon of Delmont loam, in an area of Delmont-Enet loams, 0 to 2 percent slopes, 80 feet south and 99 feet west of the northeast corner of sec. 19, T. 98 N., R. 52 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

B21—8 to 12 inches; very dark grayish brown (10YR 3/2) loam, black (10YR 2/1) moist; weak medium prismatic structure parting to weak medium and coarse subangular blocky; soft, very friable; neutral; clear wavy boundary.

B22—12 to 18 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, very friable; neutral; clear smooth boundary.

IIC1ca—18 to 23 inches; multicolored gravelly sand; single grain; loose; calcium carbonate coatings on the underside of pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

IIC2ca—23 to 60 inches; multicolored gravelly sand; single grain; loose; calcium carbonate coatings on the underside of some pebbles; strong effervescence; moderately alkaline.

The depth to gravelly material ranges from 14 to 20 inches. The thickness of the solum and the depth to free carbonates range from 14 to 20 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches. The clay content in the part of the control section above the gravelly material averages as low as 18 percent in some pedons and as high as 27 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It is neutral or mildly alkaline. The B2 horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is neutral or mildly alkaline. It typically is loam but in some pedons is sandy loam in the lower part. The IIC horizon is multicolored, stratified gravelly sand or gravelly loamy sand. It is mildly alkaline or moderately alkaline.

Dempster series

The Dempster series consists of well drained soils that are moderately deep over sandy and gravelly material. These soils are on terraces. Permeability is moderate in the solum and rapid in the underlying material. Slopes range from 1 to 5 percent.

Dempster soils are similar to Enet soils and are near Blendon, Graceville, Henkin, and Wentworth soils. Blendon and Henkin soils are higher on the landscape than the Dempster soils. Also, they contain more sand and less clay in the solum. Egan and Wentworth soils do not have gravelly material within a depth of 60 inches. They are in positions on the landscape similar to those of the Dempster soils. Enet soils contain more sand in the solum than the Dempster soils. Graceville soils have gravelly material 40 to 60 inches from the surface. They are slightly lower on the landscape than the Dempster soils.

Typical pedon of Dempster silty clay loam, in an area of Dempster-Graceville silty clay loams, 1 to 5 percent slopes, 400 feet north and 495 feet east of the southwest corner of sec. 25, T. 96 N., R. 52 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; medium acid; abrupt smooth boundary.

B21—8 to 14 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; clear wavy boundary.

B22—14 to 26 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; weak medium prismatic structure parting to weak medium subangluar blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

B3ca—26 to 34 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; strong effervescence; moderately alkaline; gradual smooth boundary.

IIC1ca—34 to 52 inches; brown (10YR 5/3) gravelly loamy sand, dark brown (10YR 4/3) moist; single grain; loose; common fine accumulations of carbonate; calcium carbonate coatings on the underside of gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

IIC2—52 to 60 inches; pale brown (10YR 6/3) gravelly sand, brown (10YR 5/3) moist; common fine distinct strong brown (7.5YR 5/6) mottles; single grain; loose; calcium carbonate coatings on the underside of gravel; strong effervescence; moderately alkaline.

The thickness of the solum, or the depth to gravelly material, ranges from 20 to 36 inches. The depth to free carbonates also ranges from 20 to 36 inches. The thickness of the mollic epipedon ranges from 12 to 20 inches.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It is medium acid to neutral. The B2 horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is silty clay loam or silt loam. It is slightly acid or neutral. The IIC horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 to 4. It is mildly alkaline or moderately alkaline.

Dimo series

The Dimo series consists of somewhat poorly drained soils that are moderately deep over sandy and gravelly material. These soils are in swales on terraces. Permeability is moderate in the solum and rapid in the underlying material. Slopes range from 0 to 2 percent.

Dimo soils are near Arlo, Clamo, Delmont, and Enet soils. The poorly drained Arlo and Clamo soils are slightly lower on the landscape than the Dimo soils. Arlo soils have a calcic horizon. Clamo soils contain more clay in the solum than the Dimo soils and are deeper to sand and gravel. The somewhat excessively drained Delmont and well drained Enet soils are higher on the landscape than the Dimo soils.

Typical pedon of Dimo clay loam, 2,165 feet west and 60 feet north of the southeast corner of sec. 29, T. 98 N., R. 52 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) clay loam, black (10YR 2/1) moist; weak fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; medium acid; abrupt smooth boundary.

B21—9 to 20 inches; very dark gray (10YR 3/1) clay loam, black (10YR 2/1) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; slightly acid; gradual wavy boundary.

B22—20 to 25 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; common fine distinct black (10YR 2/1) and yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine dark concretions (iron and manganese oxide); neutral; gradual wavy boundary.

B3—25 to 29 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct light olive brown (2.5Y 5/6) and black (N 2/0) mottles; weak medium subangular blocky structure; slightly hard, very friable; common fine dark concretions (iron and manganese oxide); slight effervescence; neutral; clear smooth boundary.

IIC1ca—29 to 42 inches; light gray (5Y 7/1) gravelly loamy sand, grayish brown (2.5Y 5/2) moist; few fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; calcium carbonate coatings on pebbles; common shale chips; strong effervescence; mildly alkaline; clear smooth boundary.

IIC2—42 to 60 inches; multicolored gravelly sand; single grain; loose; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 20 to 40 inches. The depth to sand and gravel and the thickness of the mollic epipedon also range from 20 to 40 inches. The clay content in the part of the control section above the sand and gravel averages as low as 25 percent in some pedons and as high as 35 percent in others.

The A horizon has value of 3 or 4 (2 moist). It typically is clay loam but in some pedons is loam. It is medium acid to neutral. The B2 horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is clay loam, loam, or sandy clay loam. It is slightly acid or neutral. The IIC horizon is multicolored gravelly sand or gravelly loamy sand. It is mildly alkaline or moderately alkaline.

Egan series

The Egan series consists of deep, well drained soils formed in a mantle of silty sediments over loamy glacial till. These soils are on uplands. Permeability is moderate in the solum and moderately slow in the underlying material. Slopes range from 0 to 9 percent.

Egan soils are similar to Huntimer and Wentworth soils and are near Chancellor, Ethan, Tetonka, Trent, and Wentworth soils. The somewhat poorly drained Chancellor soils are in swales and drainageways. Ethan soils contain more sand than the Egan soils and have free carbonates at or near the surface. They are on knolls and the more sloping parts of the landscape. Huntimer soils contain more clay in the subsoil than the Egan soils. The poorly drained Tetonka soils are in depressions. Trent soils have a mollic epipedon that is more than 20 inches thick. They are in swales. Wentworth soils do not have glacial till within a depth of 40 inches.

Typical pedon of Egan silty clay loam, in an area of Egan-Ethan complex, 2 to 6 percent slopes, 835 feet north and 140 feet west of the southeast corner of sec. 19, T. 97 N., R. 55 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; abrupt smooth boundary.

B21—8 to 12 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; gradual wavy boundary.

B22—12 to 30 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

IIB3ca—30 to 36 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; strong effervescence; mildly alkaline; clear wavy boundary.

IIC—36 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; common fine distinct strong brown (7.5YR 5/6) and gray (5Y 6/1) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 40 inches. The depth to free carbonates ranges from 15 to 30 inches. The thickness of the mollic epipedon ranges from 8 to 19 inches. The clay content of the control section averages as low as 25 percent in some pedons and as high as 35 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It typically is silty clay loam but in some pedons is silt loam. It is slightly acid or neutral. The B2 horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. It is neutral or mildly alkaline. The IIC horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 4. It is clay loam or loam. It is mildly alkaline or moderately alkaline.

Enet series

The Enet series consists of well drained soils that are moderately deep over sandy and gravelly material. These soils are on terraces. Permeability is moderate in the subsoil and rapid in the underlying material. Slopes range from 0 to 6 percent.

Enet soils are similar to Delmont and Dempster soils and are near Baltic, Blendon, Delmont, and Dimo soils. Baltic and Blendon soils are not underlain by gravelly material. The very poorly drained Baltic soils are in depressions. Blendon soils contain less clay in the subsoil than the Enet soils. They are in positions on the landscape similar to those of the Enet soils. Delmont soils are 14 to 20 inches deep over gravelly material. They are higher on the landscape than the Enet soils. Dempster soils contain more silt and less sand in the subsoil than the Enet soils. The somewhat poorly drained Dimo soils are in swales and depressions.

Typical pedon of Enet loam, in an area of Delmont-Enet loams, 0 to 2 percent slopes (fig. 10), 1,400 feet south and 106 feet west of the northeast corner of sec. 19, T. 98 N., R. 52 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

B2—8 to 20 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, very friable; neutral; clear wavy boundary.

B3—20 to 24 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable; neutral; clear smooth boundary.

IIC1ca—24 to 29 inches; grayish brown (2.5Y 5/2) gravelly loamy sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose; calcium carbonate coatings on the underside of gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

IIC2—29 to 60 inches; multicolored gravelly sand; single grain; loose; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 20 to 40 inches. The depth to gravelly material and the thickness of the mollic epipedon also range from 20 to 40 inches. The clay content in the part of the control section above the sand and gravel averages as low as 18 percent in some pedons and as high as 27 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It is slightly acid or neutral. The B2 horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is neutral or mildly alkaline. The IIC horizon is mildly alkaline or moderately alkaline.

Ethan series

The Ethan series consists of deep, well drained soils formed in loamy glacial till on uplands. Permeability is moderate in the solum and moderately slow in the underlying material. Slopes range from 1 to 25 percent.

Figure 10.—Profile of Enet loam. Gravelly sand is at a depth of about 28 inches. Depth is marked in feet.

Ethan soils are similar to Betts soils and are near Betts, Clarno, Egan, Tetonka, and Wentworth soils. Betts soils do not have a mollic epipedon. Clarno, Egan, and Wentworth soils are deeper to free carbonates than the Ethan soils. Also, they are on less sloping parts of the landscape. The poorly drained Tetonka soils are in depressions.

Typical pedon of Ethan loam, in an area of Egan-Ethan complex, 2 to 6 percent slopes, 1,040 feet north and 140 feet west of the southeast corner of sec. 19, T. 97 N., R. 55 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence (about 11 percent calcium carbonate); mildly alkaline; abrupt smooth boundary.

ACca—8 to 21 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; violent effervescence (about 28 percent calcium carbonate); mildly alkaline; gradual wavy boundary.

C1ca—21 to 32 inches; light gray (2.5Y 7/2) clay loam, light brownish gray (2.5Y 6/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; violent effervescence (about 22 percent calcium carbonate); moderately alkaline; gradual wavy boundary.

C2—32 to 60 inches; pale yellow (2.5Y 7/4) clay loam, light yellowish brown (2.5Y 6/4) moist; common fine distinct strong brown (7.5YR 5/6) and gray (5Y 6/1) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; violent effervescence (about 18 percent calcium carbonate); mildly alkaline.

The thickness of the solum ranges from 18 to 30 inches. The depth to free carbonates is 0 to 9 inches. The thickness of the mollic epipedon ranges from 7 to 10 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It typically is loam but in some pedons is clay loam. It is neutral or mildly alkaline. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is clay loam or loam. It is mildly alkaline or moderately alkaline. The mottles in this horizon are inherited from the parent material.

Graceville series

The Graceville series consists of deep, well drained soils formed in silty and loamy deposits over sandy and gravelly material. These soils are on terraces. Permeability is moderate in the subsoil and rapid in the underlying material. Slopes are 1 to 2 percent.

Graceville soils are similar to Davis and Trent soils and are near Blendon, Dempster, Egan, Henkin, and Wentworth soils. Blendon and Henkin soils contain more sand and less clay in the solum than the Graceville soils. Also, they are higher on the landscape. Davis soils contain more sand in the solum than the Graceville soils.

Dempster soils are underlain by gravelly material at a depth of 20 to 40 inches. They are higher on the landscape than the Graceville soils. Egan, Trent, and Wentworth soils do not have sand and gravel within a depth of 60 inches. They are on uplands.

Typical pedon of Graceville silty clay loam, in an area of Dempster-Graceville silty clay loams, 1 to 5 percent slopes, 510 feet east and 665 feet north of the southwest corner of sec. 25, T. 96 N., R. 52 W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine granular structure; hard, friable, slightly sticky and slightly plastic; medium acid; abrupt smooth boundary.

A12—10 to 18 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine subangular blocky structure parting to weak fine granular; hard, friable, slightly sticky and slightly plastic; medium acid; clear wavy boundary.

B1—18 to 24 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak coarse prismatic structure parting to weak medium and fine subangular blocky; hard, friable, slightly sticky and slightly plastic; medium acid; gradual wavy boundary.

B21—24 to 39 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; slightly acid; gradual wavy boundary.

B22—39 to 52 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, friable, slightly sticky and slightly plastic; slightly acid; gradual wavy boundary.

IIC—52 to 60 inches; dark brown (10YR 4/3) gravelly loamy sand, dark brown (10YR 3/3) moist; common medium distinct strong brown (7.5YR 5/8) mottles; single grain; loose; slightly acid.

The thickness of the solum, or the depth to gravelly material, ranges from 40 to 60 inches. The depth to free carbonates ranges from 40 to more than 60 inches. The thickness of the mollic epipedon ranges from 20 to 48 inches. The clay content of the control section averages as low as 25 percent in some pedons and as high as 35 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It typically is silty clay loam but in some pedons is loam or silt loam. It ranges from medium acid to neutral. The B2 horizon has value of 4 to 6 (2 to 4 moist) and chroma of 2 to 4. It is silt loam or silty clay loam. It is slightly acid or neutral. The IIC horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is gravelly loamy sand, gravelly sand, loamy sand, or sand. It ranges from slightly acid to mildly alkaline.

Henkin series

The Henkin series consists of deep, well drained soils formed in loamy and sandy alluvium on terraces. Permeability is moderately rapid in the upper part of the profile and moderately rapid or rapid in the lower part. Slopes range from 2 to 6 percent.

Henkin soils are similar to Blendon soils and are near Blendon, Davis, Delmont, and Enet soils. They are in positions on the landscape similar to those of the nearby soils. Blendon soils have a mollic epipedon that is more than 20 inches thick. Davis soils contain less sand and more clay in the surface layer and subsoil than the Henkin soils. Delmont and Enet soils are underlain by gravelly material.

Typical pedon of Henkin fine sandy loam, in an area of Blendon-Henkin fine sandy loams, 2 to 6 percent slopes, 1,485 feet east and 1,205 feet south of the northwest corner of sec. 20, T. 98 N., R. 52 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

B21—7 to 12 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, very friable; neutral; gradual wavy boundary.

B22—12 to 19 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, very friable; mildly alkaline; gradual wavy boundary.

B3—19 to 30 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, very friable; strong effervescence; mildly alkaline; gradual wavy boundary.

C1—30 to 48 inches; light gray (2.5Y 7/2) fine sandy loam, light brownish gray (2.5Y 6/2) moist; weak medium subangular blocky structure; soft, very friable; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—48 to 60 inches; light gray (2.5Y 7/2) loamy sand, light brownish gray (2.5Y 6/2) moist: massive; soft, very friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 21 to 40 inches. The depth to free carbonates ranges from 18 to 45 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches. The clay content of the control

section averages as low as 10 percent in some pedons and as high as 18 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It ranges from medium acid to neutral. The B2 horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. It is fine sandy loam or sandy loam. It is mildly alkaline or neutral. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It ranges from neutral to moderately alkaline. It is fine sandy loam, sandy loam, or loamy sand. In some pedons gravelly material is below a depth of 40 inches.

Huntimer series

The Huntimer series consists of deep, well drained soils formed in silty and clayey lake sediments on uplands. Permeability is slow. Slopes range from 0 to 2 percent.

Huntimer soils are similar to Egan and Wentworth soils and are near Chancellor, Egan, Ethan, Tetonka, and Worthing soils. The somewhat poorly drained Chancellor soils are in swales and drainageways. Egan and Wentworth soils contain less clay in the subsoil than the Huntimer soils. Ethan soils have free carbonates at or near the surface. They are on knolls and the more sloping parts of the landscape. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions.

Typical pedon of Huntimer silty clay loam, 0 to 2 percent slopes, 990 feet south and 270 feet east of the northwest corner of sec. 36, T. 100 N., R. 52 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine granular structure; hard, friable, sticky and plastic; slightly acid; abrupt smooth boundary.

B21—8 to 15 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm, sticky and plastic; slightly acid; gradual wavy boundary.

B22—15 to 20 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm, sticky and plastic; neutral; clear wavy boundary.

B3ca—20 to 26 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm, sticky and plastic; common fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C1ca—26 to 44 inches; light gray (2.5Y 7/2) silty clay loam, grayish brown (2.5Y 5/2) moist; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine accumualtions of carbonate; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—44 to 60 inches; light gray (5Y 7/1) silty clay loam stratified with thin layers of loam and clay loam; gray (5Y 5/1) moist; many medium and coarse distinct yellowish brown (10YR 5/6) mottles; massive; hard, friable, slightly sticky and slightly plastic; few fine dark concretions (iron and manganese oxide); slight effervescence; moderately alkaline.

The thickness of the solum ranges from 25 to 35 inches. The depth to free carbonates ranges from 14 to 28 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches. The clay content of the control section averages as low as 35 percent in some pedons and as high as 45 percent in others.

The A horizon has value of 3 or 4 (2 moist) and chroma of 1 or 2. It typically is silty clay loam but in some pedons is silty clay. It ranges from medium acid to neutral. The B2 horizon has value of 4 or 5 (2 to 4 moist) and chroma of 1 to 3. It is silty clay or silty clay loam. It is slightly acid or neutral. The C horizon has value of 5 to 7 (4 or 5 moist) and chroma of 1 to 4. It is mildly alkaline or moderately alkaline. The mottles in this horizon are inherited from the parent material. Loamy glacial till is below a depth of 40 inches in some pedons.

Lamo series

The Lamo series consists of deep, somewhat poorly drained soils formed in calcareous silty alluvium on flood plains. Permeability is moderately slow. Slopes range from 0 to 2 percent.

Lamo soils are near Chaska, Clamo, Davis, Roxbury, and Salmo soils. Chaska soils contain more sand throughout than the Lamo soils. They are in drainageways. The poorly drained Clamo soils contain more clay throughout than the Lamo soils. They are in positions on the landscape similar to those of the Lamo soils. The well drained Davis and Roxbury soils are higher on the flood plains than the Lamo soils. The poorly drained Salmo soils are lower on the flood plains than the Lamo soils. They have visible salts at or near the surface.

Typical pedon of Lamo silty clay loam, 2,610 feet north and 825 feet east of the southwest corner of sec. 3, T. 97 N., R. 54 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; mildly alkaline; abrupt smooth boundary.

A12—8 to 15 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; mildly alkaline; gradual smooth boundary.

AC—15 to 27 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; strong effervescence; mildly alkaline; clear wavy boundary.

C1cs—27 to 35 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; common fine distinct light olive brown (2.5Y 5/6) and gray (5Y 5/1) mottles; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine nests of gypsum; common fine accumulations of carbonate; strong effervescence; mildly alkaline; clear wavy boundary.

C2g—35 to 60 inches; gray (5Y 6/1) silty clay loam, dark gray (5Y 4/1) moist; common fine faint olive (5Y 5/3) mottles; massive; hard, firm, sticky and plastic; few fine dark concretions (iron and manganese oxide); few gypsum crystals; few fine accumulations of carbonate; strong effervescence; mildly alkaline.

The thickness of the solum and the thickness of the mollic epipedon range from 24 to 35 inches. The depth to free carbonates is less than 10 inches. The soils are mildly alkaline or moderately alkaline throughout. The clay content of the control section averages as low as 28 percent in some pedons and as high as 35 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist). It typically is silty clay loam but in some pedons is silt loam. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 or 2. Some pedons have thin layers of silty clay. Some have a buried A horizon. Some do not have accumulations of gypsum crystals.

Roxbury series

The Roxbury series consists of deep, well drained soils formed in calcareous silty and loamy alluvium on flood plains. Permeability is moderate. Slopes range from 0 to 2 percent.

Roxbury soils are similar to Alcester, Davis, and Roxbury Variant soils and are near those soils and Chaska, Clamo, and Lamo soils. Alcester and Davis soils are deeper to free carbonates than the Roxbury soils. The somewhat poorly drained Chaska soils are in drainageways. The poorly drained Clamo soils contain more clay than the Roxbury soils. Also, they are slightly lower on the flood plains. The somewhat poorly drained Lamo soils are lower on the flood plains than the Roxbury soils. Roxbury Variant soils contain more clay in the subsoil and underlying material than the Roxbury soils.

Typical pedon of Roxbury silt loam, 303 feet west and 480 feet south of the northeast corner of sec. 29, T. 100 N., R. 53 W.

Ap—0 to 9 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12—9 to 20 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; mildly alkaline; gradual wavy boundary.

B2—20 to 36 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual smooth boundary.

C1—36 to 52 inches; light brownish gray (2.5Y 6/2) loam stratified with thin layers of silt loam and fine sandy loam; dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable; few fine accumulations of carbonate; strong effervescence; moderately alkaline; clear smooth boundary.

C2—52 to 60 inches; light brownish gray (10YR 6/2) silt loam stratified with thin layers of loam and fine sandy loam; dark grayish brown (10YR 4/2) moist; common medium distinct dark brown (7.5YR 4/4) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 25 to 50 inches. The depth to free carbonates is less than 15 inches. The thickness of the mollic epipedon ranges from 20 to 45 inches. The clay content of the control section averages as low as 20 percent in some pedons and as high as 30 percent in others.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It typically is silt loam but in some pedons is silty clay loam or loam. It is neutral or mildly alkaline. The B2 horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is silt loam or silty clay loam. It is mildly alkaline or moderately alkaline. The C horizon has value of 5 or 6 (4 or 5 moist). It is silt loam, loam, or silty clay loam stratified with thin layers of sandy material. Some pedons have a buried A horizon below a depth of 40 inches.

Roxbury Variant

The Roxbury Variant consists of deep, moderately well drained soils formed in silty alluvium over clayey alluvium. These soils are on flood plains. Permeability is moderate in the upper part of the soil and slow in the subsoil. Slopes range from 0 to 2 percent.

Roxbury Variant soils are similar to Davis and Roxbury soils and are near Chaska, Clamo, and Roxbury soils. The somewhat poorly drained Chaska soils are in drainageways. The poorly drained Clamo soils are lower on the flood plains than the Roxbury Variant soils. Davis soils are well drained. Roxbury soils are silty throughout.

Typical pedon of Roxbury Variant silt loam, 125 feet east and 1,610 feet south of the northwest corner of sec. 10, T. 97 N., R. 52 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

A12—8 to 12 inches; very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

A13—12 to 24 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; strong effervescence; mildly alkaline; abrupt smooth boundary.

IIB2g—24 to 37 inches; very dark gray (N 3/0) silty clay, black (N 2/0) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; few fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

IIB3gca—37 to 45 inches; very dark gray (5Y 3/1) clay, black (5Y 2/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; common fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

IICca—45 to 60 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct strong brown (7.5YR 5/6) and black (N 2/0) mottles; massive; hard, friable, slightly sticky and slightly plastic; common fine dark concretions of iron and manganese oxide; common fine accumulations of carbonate; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 35 to 55 inches. The depth to free carbonates is less than 15 inches. The thickness of the mollic epipedon ranges from 30 to 55 inches. The depth to clayey material ranges from 20 to 40 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It typically is silt loam but in some pedons is silty clay loam. It is neutral or mildly alkaline. The IIB2g horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or less. It is clay or silty clay. It is mildly alkaline or moderately alkaline. The IIC horizon has hue of 5Y or 2.5Y, value of 4 to 6 (2 to 4 moist), and chroma of 1 or 2. It is clay loam, silty clay loam, clay, or silty clay. It is mildly alkaline or moderately alkaline.

Salmo series

The Salmo series consists of deep, poorly drained soils formed in calcareous silty and loamy alluvium on flood plains. Permeability is moderately slow. Slopes are less than 1 percent.

Salmo soils commonly are near Baltic and Lamo soils. These nearby soils do not have visible salts near the surface. Also, Baltic soils contain more clay than the Salmo soils.

Typical pedon of Salmo silty clay loam, 445 feet north and 1,023 feet west of the southeast corner of sec. 26, T. 98 N., R. 54 W.

A11—0 to 3 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; few fine accumulations of salt; slight effervescence (about 6 percent calcium carbonate); moderately alkaline; clear wavy boundary.

A12sa—3 to 8 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; common fine distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to weak fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine accumulations of salt; slight effervescence (about 6 percent calcium carbonate); moderately alkaline; clear wavy boundary.

A13gsa—8 to 19 inches; very dark gray (N 3/0) silty clay loam, black (N 2/0) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, sticky and plastic; many fine accumulations of salt; strong effervescence (about 7 percent calcium carbonate); moderately alkaline; clear wavy boundary.

A14gsacs—19 to 28 inches; dark gray (N 4/0) silty clay loam, black (N 2/0) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; common fine accumulations of salt; common fine nests of gypsum; strong effervescence (about 14 percent calcium carbonate); mildly alkaline; gradual wavy boundary.

C1gcs—28 to 36 inches; dark gray (N 4/0) silty clay loam, black (N 2/0) moist; massive; very hard, friable, sticky and plastic; common gypsum crystals; strong effervescence (about 10 percent calcium carbonate); mildly alkaline; gradual wavy boundary.
C2g—36 to 60 inches; dark gray (N 4/0) clay loam, black (N 2/0) moist; massive; very hard, friable, sticky and plastic; strong effervescence (about 9 percent calcium carbonate); mildly alkaline.

The thickness of the solum and the thickness of the mollic epipedon range from 24 to 45 inches. Visible salts or gypsum crystals are at or near the surface. The soils have free carbonates throughout. The clay content of the control section averages as low as 24 percent in some pedons and as high as 35 percent in others.

The A horizon is neutral in hue or has hue of 10YR or 5Y. It has value of 3 or 4 (2 or 3 moist) and chroma of 1 or less. It typically is silty clay loam but in some pedons is silt loam. It is mildly alkaline or moderately alkaline. It has few to many accumulations of salt. The C horizon is neutral in hue or has hue of 5Y or 2.5Y, value of 3 to 6 (2 to 4 moist), and chroma of 1 or 2. It is mildly alkaline or moderately alkaline. It is silty clay loam, silt loam, silty clay, clay loam, or loam. Sand and gravel are below a depth of 40 inches in some pedons.

Talmo series

The Talmo series consists of excessively drained, rapidly permeable soils that are very shallow over sand and gravel. These soils formed in gravelly outwash on uplands. Slopes range from 12 to 25 percent.

Talmo soils are near Betts, Delmont, and Ethan soils. Betts and Ethan soils are loamy throughout. They are in positions on the landscape similar to those of the Talmo soils. Delmont soils are deeper to sand and gravel than the Talmo soils. They are on the less sloping parts of the landscape.

Typical pedon of Talmo gravelly loam, in an area of Betts-Talmo complex, 12 to 40 percent slopes, 2,129 feet north and 100 feet west of the southeast corner of sec. 33, T. 100 N., R. 54 W.

A1—0 to 7 inches; very dark gray (10YR 3/1) gravelly loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; calcium carbonate coatings on pebbles; slight effervescence; mildly alkaline; clear smooth boundary.
IIC1ca—7 to 41 inches; pale brown (10YR 6/3) gravelly loamy sand, brown (10YR 4/3) moist; single grain; loose; calcium carbonate coatings on pebbles; strong effervescence; mildly alkaline; gradual smooth boundary.
IIC2—41 to 45 inches; multicolored very gravelly sand; single grain; loose; calcium carbonate coatings on the underside of pebbles; strong effervescence; moderately alkaline; clear smooth boundary.
IIC3—45 to 60 inches; very pale brown (10YR 7/3) gravelly loamy sand, brown (10YR 5/3) moist; single grain; loose; strong effervescence; moderately alkaline.

The thickness of the solum, or the depth to gravelly sand, ranges from 5 to 14 inches. The thickness of the mollic epipedon ranges from 7 to 14 inches. The depth to free carbonates is 0 to 10 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It typically is gravelly loam but in some pedons is loam or sandy loam. It is neutral or mildly alkaline. The IIC horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It dominantly is gravelly loamy sand or gravelly sand but has layers of very gravelly loamy sand or very gravelly sand. It is mildly alkaline or moderately alkaline.

Tetonka series

The Tetonka series consists of deep, poorly drained soils formed in local silty and clayey alluvium in depressions on uplands. Permeability is slow. Slopes are 0 to 1 percent.

Tetonka soils are similar to Baltic and Worthing soils and are near Chancellor, Clarno, Crossplain, Davison, Wakonda, and Wentworth soils. Baltic and Worthing soils are very poorly drained. The somewhat poorly drained Chancellor and Crossplain soils are in swales and shallow drainageways. The well drained and moderately well drained Clarno and Wentworth soils are higher on the landscape than the Tetonka soils. The moderately well drained Davison and Wakonda soils have a calcic horizon. They are on slight rises above the Tetonka soils.

Typical pedon of Tetonka silt loam, 1,205 feet west and 710 feet north of the southeast corner of sec. 16, T. 100 N., R. 53 W.

A11—0 to 9 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; clear smooth boundary.
A12—9 to 12 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak medium platy structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; gradual smooth boundary.
A2—12 to 18 inches; light gray (10YR 6/1) silt loam, dark gray (10YR 4/1) moist; weak thin and medium platy structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.
B21tg—18 to 27 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; moderate medium and coarse prismatic structure parting to moderate fine and medium blocky; very hard, firm, sticky and plastic; slightly acid; gradual wavy boundary.

B22tg—27 to 34 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; slightly acid; gradual wavy boundary.

B3—34 to 46 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; common fine dark concretions (iron and manganese oxide); few fine accumulations of carbonate; strong effervescence; neutral; gradual wavy boundary.

Cca—46 to 60 inches; light gray (2.5Y 7/2) silty clay loam, light brownish gray (2.5Y 6/2) moist; common fine distinct yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable, sticky and plastic; common fine dark concretions (iron and manganese oxide); common fine accumulations of carbonate; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 30 to 60 inches. The depth to free carbonates ranges from 30 to more than 60 inches. The thickness of the mollic epipedon ranges from 30 to 50 inches. The clay content of the control section averages as low as 35 percent in some pedons and as high as 55 percent in others.

The A horizon typically is silt loam but in some pedons is silty clay loam or loam. It ranges from medium acid to neutral. The A2 horizon has value of 5 to 7 (3 to 5 moist) and chroma of 1 or 2. The B2t horizon is neutral in hue or has hue of 10YR to 5Y. It has value of 4 or 5 (2 to 4 moist). It is clay, clay loam, or silty clay. It is slightly acid or neutral. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 or 2. It is silty clay loam, clay loam, or silty clay. It is mildly alkaline or moderately alkaline. Accumulations of gypsum are in some pedons.

Trent series

The Trent series consists of deep, moderately well drained soils formed in local alluvium in swales on uplands. Permeability is moderate. Slopes range from 0 to 2 percent.

Trent soils are similar to Alcester, Bonilla, and Graceville soils and are near Chancellor, Egan, and Wentworth soils. Alcester soils irregularly decrease in content of organic matter as the depth increases. Bonilla soils contain more sand throughout than the Trent soils. The somewhat poorly drained Chancellor soils are in positions on the landscape similar to those of the Trent soils. The well drained Egan and Wentworth soils have a mollic epipedon that is less than 20 inches thick. They are higher on the landscape than the Trent soils. The well drained Graceville soils are underlain by gravelly material.

Typical pedon of Trent silty clay loam, in an area of Egan-Trent silty clay loams, 0 to 2 percent slopes, 237 feet south and 990 feet east of the northwest corner of sec. 1, T. 99 N., R. 53 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; medium acid; abrupt smooth boundary.

A12—8 to 12 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; medium acid; clear wavy boundary.

B21—12 to 26 inches; very dark grayish brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; gradual wavy boundary.

B22—26 to 38 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; common fine faint olive brown (2.5Y 4/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; clear wavy boundary.

B3ca—38 to 42 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct light olive brown (2.5Y 5/6) and black (10YR 2/1) mottles; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; strong effervescence; mildly alkaline; clear wavy boundary.

C1ca—42 to 60 inches; light gray (2.5Y 7/2) silty clay loam, light brownish gray (2.5Y 6/2) moist; few fine distinct yellowish brown (10YR 5/6) and black (10YR 2/1) mottles; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine accumulations of carbonate; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 35 to 55 inches. The depth to free carbonates ranges from 30 to 50 inches. The thickness of the mollic epipedon ranges from 20 to 35 inches. The clay content of the control section averages as low as 27 percent in some pedons and as high as 35 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist). It typically is silty clay loam but in some pedons is silt loam. It ranges from neutral to medium acid. The B2 horizon has value of 3 to 6 (2 to 5 moist) and chroma of

2 or 3. It is neutral or slightly acid. The C horizon has hue of 10YR or 2.5Y, value of 6 or 7 (5 or 6 moist), and chroma of 2 or 3. It is mildly alkaline or moderately alkaline. It is silty clay loam or silt loam. Loamy glacial till is below a depth of 40 inches in some pedons.

Wakonda series

The Wakonda series consists of deep, moderately well drained soils formed in a thin mantle of silty sediments over loamy glacial till. These soils are on low rises above swales and depressions on uplands. Permeability is moderate in the solum and moderately slow in the underlying glacial till. Slopes range from 0 to 2 percent.

Wakonda soils are similar to Davison soils and are near Chancellor, Egan, Tetonka, Wentworth, and Worthing soils. The nearby soils do not have a calcic horizon. The somewhat poorly drained Chancellor soils are in swales and shallow drainageways. Davison soils contain more sand in the upper part than the Wakonda soils. The well drained Egan and Wentworth soils are on side slopes. The poorly drained Tetonka and very poorly drained Worthing soils are in depressions.

Typical pedon of Wakonda silty clay loam, in an area of Wentworth-Chancellor-Wakonda silty clay loams, 0 to 2 percent slopes, 2,610 feet north and 163 feet west of the southeast corner of sec. 12, T. 96 N., R. 52 W.

Ap—0 to 8 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence (about 14 percent calcium carbonate); moderately alkaline; abrupt smooth boundary.

ACca—8 to 15 inches; dark gray (10YR 4/1) and olive brown (2.5Y 4/4) silty clay loam, very dark gray (10YR 3/1) and very dark grayish brown (2.5Y 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine concretions (iron and manganese oxide); violent effervescence (about 15 percent calcium carbonate); moderately alkaline; clear wavy boundary.

C1ca—15 to 32 inches; light brownish gray (2.5Y 6/2) silty clay loam, olive brown (2.5Y 4/4) moist; common fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few gypsum crystals; few fine concretions (iron and manganese oxide); common fine accumulations of carbonate; violent effervescence (about 25 percent calcium carbonate); moderately alkaline; clear wavy boundary.

C2cacs—32 to 39 inches; light yellowish brown (2.5Y 6/4) loam, light olive brown (2.5Y 5/4) moist; common fine distinct gray (5Y 6/1) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine gypsum crystals; few fine accumulations of carbonate; strong effervescence (about 14 percent calcium carbonate); moderately alkaline; clear wavy boundary.

IIC3cs—39 to 54 inches; pale yellow (2.5Y 7/4) clay loam, light yellowish brown (2.5Y 6/4) moist; common fine distinct gray (5Y 6/1) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine nests of gypsum; common fine accumualtions of carbonate; strong effervescence (about 12 percent calcium carbonate); moderately alkaline; clear wavy boundary.

IIC4—54 to 60 inches; pale yellow (2.5Y 7/4) clay loam, light olive brown (2.5Y 5/4) moist; few fine distinct strong brown (7.5YR 5/6) and light gray (5Y 7/1) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few gypsum crystals; common fine accumulations of carbonate; strong effervescence (about 10 percent calcium carbonate); moderately alkaline.

The thickness of the solum and the thickness of the mollic epipedon range from 7 to 16 inches. The soils contain free carbonates throughout.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It typically is silty clay loam but in some pedons is silt loam. It ranges from neutral to moderately alkaline. The C horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 to 4. It is silty clay loam, silt loam, or loam. It is mildly alkaline or moderately alkaline. The IIC horizon has hue of 2.5Y or 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 to 4. It is clay loam or loam. Some pedons do not have glacial till within a depth of 40 inches.

Wentworth series

The Wentworth series consists of deep, moderately well drained and well drained soils formed in a mantle of silty sediments over loamy glacial till. These soils are on uplands. Permeability is moderate in the silty material and moderately slow in the glacial till. Slopes range from 0 to 6 percent.

Wentworth soils are similar to Egan and Huntimer soils and commonly are near Chancellor, Egan, Tetonka, Trent, and Wakonda soils. The somewhat poorly drained Chancellor soils are in swales and shallow drainageways. Egan soils are underlain by clay loam glacial till at a depth of 20 to 40 inches. Huntimer soils contain more clay in the subsoil than the Wentworth soils. The poorly drained Tetonka soils are in depressions. Trent soils

have a mollic epipedon that is more than 20 inches thick. They are in swales. Wakonda soils have a calcic horizon. They are on slight rises above swales.

Typical pedon of Wentworth silty clay loam, in an area of Wentworth-Chancellor-Wakonda silty clay loams, 0 to 2 percent slopes, 2,627 feet south and 327 feet west of the northeast corner of sec. 12, T. 96 N., R. 52 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; abrupt smooth boundary.

B21—9 to 16 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; gradual wavy boundary.

B22—16 to 22 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine dark concretions (iron and manganese oxide); neutral; clear wavy boundary.

B3ca—22 to 30 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; few fine faint very dark grayish brown (2.5Y 3/2) and few fine distinct olive brown (2.5Y 4/4) mottles; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

C1ca—30 to 42 inches; pale yellow (2.5Y 7/4) silty clay loam, light yellowish brown (2.5Y 6/4) moist; few fine distinct very dark brown (10YR 2/2) and few fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine dark concretions (iron and manganese oxide); few fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual smooth boundary.

IIC2cacs—42 to 60 inches; light gray (2.5Y 7/2) clay loam, light yellowish brown (2.5Y 6/4) moist; common fine distinct yellowish red (5YR 4/6) and common fine distinct light gray (2.5Y 6/1) mottles; massive; hard, friable, slightly sticky and slightly plastic; few fine dark concretions (iron and mangangese oxide); common fine and medium accumulations of gypsum; common fine accumulations of carbonate; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 25 to 40 inches. The depth to free carbonates ranges from 20 to 32 inches. The depth to clay loam glacial till ranges from 40 to more than 60 inches. The thickness of the mollic epipedon ranges from 10 to 19 inches. The clay content of the control section averages as low as 25 percent in some pedons and as high as 35 percent in others.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It typically is silty clay loam but in some pedons is silt loam. It ranges from medium acid to neutral. The B2 horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 or 4 moist), and chroma of 2 or 3. It is silty clay loam or silt loam. It is slightly acid or neutral. The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is silty clay loam or silt loam. It is mildly alkaline or moderately alkaline. The IIC horizon has value of 6 or 7 (5 or 6 moist) and chroma of 2 to 4. It is clay loam or loam.

Worthing series

The Worthing series consists of deep, very poorly drained soils formed in local silty and clayey alluvium in depressions on uplands. Permeability is slow. Slopes are less than 1 percent.

Worthing soils are similar to Baltic and Tetonka soils and are near Chancellor, Crossplain, Davison, and Wakonda soils. Baltic soils have free carbonates at the surface. The somewhat poorly drained Chancellor and Crossplain soils are in swales and shallow drainageways. The moderately well drained Davison and Wakonda soils have a calcic horizon. They are on slight rises above the Worthing soils. The poorly drained Tetonka soils have an A2 horizon.

Typical pedon of Worthing silty clay loam, 1,735 feet east and 140 feet north of the southwest corner of sec. 10, T. 100 N., R. 53 W.

A11—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky and slightly plastic; medium acid; gradual smooth boundary.

A12—9 to 16 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; neutral, clear wavy boundary.

B21tg—16 to 26 inches; very dark gray (5Y 3/1) silty clay, black (5Y 2/1) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; neutral; gradual wavy boundary.

B22tg—26 to 42 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; very hard, firm, sticky and plastic; few fine dark stains (iron and manganese oxide); neutral; clear wavy boundary.

B3gca—42 to 48 inches; gray (5Y 6/1) silty clay, gray (5Y 5/1) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few fine dark stains (iron and manganese oxide); few fine accumulations of carbonate; strong effervescence; mildly alkaline; gradual wavy boundary.

Cgca—48 to 60 inches; light gray (5Y 7/1) silty clay loam, gray (5Y 6/1) moist; common fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, friable, slightly sticky and slightly plastic; common medium dark stains (iron and manganese oxide); violent effervescence; mildly alkaline.

The thickness of the solum ranges from 40 to 60 inches. The depth to free carbonates is 35 to 60 inches. The mollic epipedon is 35 to more than 60 inches thick.

The A horizon is neutral or has hue of 10 YR or 5Y and value of 3 or 4 (2 or 3 moist). It typically is silty clay loam but in some pedons is silt loam or silty clay. It ranges from medium acid to neutral. The B2t horizon has hue of 10YR or 5Y and value of 3 to 5 (2 or 3 moist). It is clay or silty clay. It is slightly acid or neutral. The C horizon has hue of 2.5Y or 5Y, value of 4 to 7 (3 to 6 moist), and chroma of 1 or 2. It is silty clay loam, clay loam, or silty clay. It is neutral to moderately alkaline.

formation of the soils

Soil forms when chemical and physical processes act on geologically deposited or accumulated material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material, the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil, the relief, and the length of time that the forces of soil formation have acted on the soil material.

Climate and plant and animal life are active factors of soil formation. They act on the parent material and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are modified by relief. The parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil having genetically related horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. The following paragraphs relate the factors of soil formation to the soils in Turner County.

climate

Climate directly influences the rate of chemical and physical weathering. Turner County has a continential climate marked by cold winters and hot summers. This climate favors the growth of grasses and the resulting accumulation of organic matter in the upper part of the soil. The precipitation is sufficient to leach carbonates in most soils to an average depth of 20 inches or more. The climate is generally uniform throughout the county and thus as a separate factor does not differentiate the soils within the county. Additional climatic data are given under the heading "General nature of the county."

plant and animal life

Plants, animals, insects, earthworms, bacteria, and fungi have an important effect on soil formation. They cause gains in organic matter, gains or losses in plant nutrients, and changes in soil structure and porosity. In Turner County the tall and mid prairie grasses have had more influence than other living organisms on soil formation. As a result of these grasses, the surface layer of many soils has a moderate or high content of organic matter. Alcester soils are an example.

Earthworms, insects, and burrowing animals help to keep the soils open and porous. Bacteria and fungi decompose plant residue, thus releasing nutrients that plants use as food.

parent material

Most of the soils in Turner County formed in glacial material that was derived from preglacial formations of granite, gneiss, limestone, quartsite, sandstone, and shale. The glacier ground up and mixed these materials as it transported them. It then redeposited them as it melted. Some deposits are unsorted material, or glacial till; others are material sorted either by water during deposition or by wind and water after deposition.

Silty drift is material that was deposited on glacial ice and then reworked by water as the glacier melted. Wentworth soils formed in silty drift. Egan soils formed in a thin mantle of silty glacial drift over the underlying loamy glacial till.

Glacial till is a mixture of clay, silt, sand, and gravel that contains few to many cobblestones and boulders. The content of pebbles and cobblestones is higher than that in silty glacial drift. The proportion of each kind of material is determined by the kind of material picked up by the glacier. Among the soils formed in glacial till are Betts, Clarno, and Ethan soils.

Glacial outwash is sandy, gravelly, and loamy material deposited by glacial melt water. Delmont, Enet, and Talmo soils formed in loamy material underlain by sand and gravel within a depth of 40 inches. Blendon and Henkin soils formed in areas where loamy and sandy outwash sediments are more than 40 inches thick.

Bonilla, Chancellor, and Tetonka are examples of soils formed partly or entirely in local alluvium washed in from adjacent sloping soils in the uplands. Clamo, Lamo, and Roxbury soils formed in alluvium deposited by streams.

relief

Relief affects drainage, runoff, erosion, plant cover, and soil temperature. Betts soils, for example, lose much rainfall because of excessive runoff. As a result of the excessive runoff, a limited amount of moisture penetrates the surface and much soil is lost through

erosion. These soils are calcareous at or near the surface. The layers in which organic matter accumulates are thin.

The runoff rate is slower on Egan and Wentworth soils than on the Betts soils. As a result, more moisture penetrates the surface and the layers in which organic matter accumulates are thicker. Also, calcium carbonate is leached to a depth of more than 10 inches.

Bonilla and Trent soils are in swales that receive extra moisture in the form of runoff from adjacent soils. The layers in which organic matter accumulates are thicker than those in the Egan and Wentworth soils. Also, calcium carbonate is leached to a greater depth. The seasonal high water table in areas where drainage is impeded favors the concentration of salts in Salmo and other soils.

time

The length of time that the climate, plant and animal life, and relief have affected the parent material helps to determine the kind of soil that forms. All of the soils in Turner County are young. The youngest are those on active flood plains, such as Chaska soils.

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glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compact layers to depths below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour farming. Growing crops in strips that follow the contour.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Drainage class (natural). Refers to the removal of water from the soil. Drainage classes are determined on the basis of an overall evaluation of water removal as influenced by climate, slope, and position on the landscape. Precipitation, runoff, amount of moisture infiltrating the soil, and rate of water movement through the soil affect the degree and duration of wetness. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow, very porous, or steep, or a combination of these.

Somewhat excessively drained.—Water is removed from the soil rapidly. The soils in this class generally

are free of mottles throughout. They commonly are shallow or moderately deep, very porous, or steep, or a combination of these.

Well drained.—Water is removed from the soil so readily that the upper 40 inches generally does not have the mottles or dull colors related to wetness.

Moderately well drained.—Water is removed from the soil so slowly that the upper 20 to 40 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Somewhat poorly drained.—Water is removed from the soil so slowly that the upper 10 to 20 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Poorly drained.—Water is removed so slowly that either the soil is periodically saturated or the upper 10 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water is at or on the surface most of the time. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water through cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:
O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.
A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.
B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the

solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.
C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.
R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

	Percent
Nearly level	0 to 2
Gently undulating	0 to 3
Gently sloping or undulating	2 to 6
Moderately sloping or gently rolling	6 to 9
Strongly sloping	9 to 15
Moderately steep	15 to 25
Steep	25 to 40

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Subsurface layer. Any surface soil horizon (A1, A2 or A3) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A horizon. Includes all subdividions of this horizon (A1, A2, and A3).

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily

rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-78 at Marion, South Dakota]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January	24.0	3.3	13.7	50	-26	0	.47	.11	.75	2	6.1
February	31.5	10.7	21.1	59	-21	0	.91	.23	1.45	3	8.4
March	41.8	20.7	31.3	74	-11	29	1.62	.66	2.42	4	9.3
April	60.1	35.2	47.6	89	16	77	2.44	1.14	3.56	5	1.3
May	72.6	46.9	59.8	92	26	316	3.23	1.52	4.69	6	.0
June	81.4	56.9	69.2	100	39	576	3.85	2.10	5.38	7	.0
July	87.0	61.8	74.5	101	47	760	2.96	1.23	4.42	6	.0
August	85.3	59.7	72.5	100	44	698	2.67	1.13	3.96	6	.0
September	75.2	49.3	62.3	98	31	373	2.71	1.25	3.95	5	.0
October	63.5	37.8	50.7	88	17	142	1.45	.33	2.33	3	.5
November	44.4	23.3	33.9	72	-5	6	.96	.21	1.55	2	4.1
December	29.9	10.6	20.3	57	-19	0	.81	.28	1.24	3	8.1
Yearly:											
Average	58.1	34.7	46.4	---	---	---	---	---	---	---	---
Extreme	---	---	---	103	-26	---	---	---	---	---	---
Total	---	---	---	---	---	2,977	24.08	18.89	28.95	52	37.8

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-78 at Marion, South Dakota]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 26	May 11	May 20
2 years in 10 later than--	April 21	May 5	May 15
5 years in 10 later than--	April 12	April 24	May 6
First freezing temperature in fall:			
1 year in 10 earlier than--	October 9	September 29	September 19
2 years in 10 earlier than--	October 14	October 4	September 24
5 years in 10 earlier than--	October 24	October 13	October 4

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-78 at Marion, South Dakota]

Probability	Daily minimum temperature		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	176	153	129
8 years in 10	182	159	136
5 years in 10	194	172	150
2 years in 10	206	184	164
1 year in 10	213	190	172

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ac	Alcester silt loam	2,100	0.5
Ar	Arlo clay loam	520	0.1
Ba	Baltic silty clay loam	4,940	1.3
Bb	Baltic silty clay loam, ponded	1,990	0.5
BeE	Betts-Ethan loams, 15 to 40 percent slopes	1,780	0.5
BhE	Betts-Talmo complex, 12 to 40 percent slopes	1,660	0.4
BkA	Blendon fine sandy loam, 0 to 2 percent slopes	900	0.2
BmB	Blendon-Henkin fine sandy loams, 2 to 6 percent slopes	780	0.2
Ca	Chancellor silty clay loam	5,990	1.5
Cc	Chaska loam, channeled	5,560	1.4
Cd	Clamo silty clay	6,530	1.7
Ce	Clamo clay, gravelly substratum	2,090	0.5
ChA	Clarno-Bonilla loams, 0 to 2 percent slopes	21,520	5.5
ChB	Clarno-Bonilla loams, 1 to 6 percent slopes	18,980	4.8
CkA	Clarno-Crossplain-Davison complex, 0 to 3 percent slopes	39,850	10.2
CmB	Clarno-Davison loams, 2 to 5 percent slopes	1,610	0.4
CoB	Clarno-Ethan loams, 2 to 6 percent slopes	20,770	5.3
CoC	Clarno-Ethan loams, 5 to 9 percent slopes	7,150	1.8
Cr	Crossplain clay loam	4,620	1.2
DaA	Davis loam, 0 to 2 percent slopes	2,910	0.7
DaB	Davis loam, 2 to 6 percent slopes	880	0.2
DbA	Davis loam, sandy substratum, 0 to 2 percent slopes	920	0.2
DeA	Delmont-Enet loams, 0 to 2 percent slopes	12,470	3.2
DeB	Delmont-Enet loams, 2 to 6 percent slopes	5,300	1.4
DgB	Dempster-Graceville silty clay loams, 1 to 5 percent slopes	1,270	0.3
Do	Dimo clay loam	2,390	0.6
EeA	Egan-Ethan complex, 0 to 2 percent slopes	910	0.2
EeB	Egan-Ethan complex, 2 to 6 percent slopes	52,260	13.4
EfA	Egan-Trent silty clay loams, 0 to 2 percent slopes	49,020	12.6
EgB	Egan-Wentworth silty clay loams, 2 to 6 percent slopes	27,800	7.1
EnA	Enet loam, 0 to 2 percent slopes	740	0.2
EsD	Ethan-Betts loams, 6 to 15 percent slopes	6,770	1.7
EtB	Ethan-Egan complex, 2 to 6 percent slopes	2,960	0.8
EtC	Ethan-Egan complex, 5 to 9 percent slopes	10,280	2.6
HuA	Huntimer silty clay loam, 0 to 2 percent slopes	880	0.2
La	Lamo silty clay loam	6,870	1.8
Or	Orthents-Aquents complex	840	0.2
Ro	Roxbury silt loam	7,050	1.8
Rv	Roxbury Variant silt loam	1,710	0.4
Sa	Salmo silty clay loam	3,510	0.9
Te	Tetonka silt loam	8,850	2.3
WaA	Wakonda-Wentworth-Chancellor silty clay loams, 0 to 3 percent slopes	1,450	0.4
WcA	Wentworth-Chancellor-Wakonda silty clay loams, 0 to 2 percent slopes	28,850	7.4
Wo	Worthing silty clay loam	4,990	1.3
	Water	460	0.1
	Total	391,680	100.0

TABLE 5.--PRIME FARMLAND

[Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name]

Map symbol	Soil name
Ac	Alcester silt loam
BkA	Blendon fine sandy loam, 0 to 2 percent slopes
BmB	Blendon-Henkin fine sandy loams, 2 to 6 percent slopes
Ca	Chancellor silty clay loam (where drained and where flooded during the growing season once or less in 2 years)
ChA	Clarno-Bonilla loams, 0 to 2 percent slopes (where flooded during the growing season once or less in 2 years)
ChB	Clarno-Bonilla loams, 1 to 6 percent slopes (where flooded during the growing season once or less in 2 years)
CkA	Clarno-Crossplain-Davison complex, 0 to 3 percent slopes (where drained and where flooded during the growing season once or less in 2 years)
CmB	Clarno-Davison loams, 2 to 5 percent slopes
CoB	Clarno-Ethan loams, 2 to 6 percent slopes
Cr	Crossplain clay loam (where drained and where flooded during the growing season once or less in 2 years)
DaA	Davis loam, 0 to 2 percent slopes
DaB	Davis loam, 2 to 6 percent slopes
DbA	Davis loam, sandy substratum, 0 to 2 percent slopes
DgB	Dempster-Graceville silty clay loams, 1 to 5 percent slopes
Do	Dimo clay loam (where flooded during the growing season once or less in 2 years)
EeA	Egan-Ethan complex, 0 to 2 percent slopes
EeB	Egan-Ethan complex, 2 to 6 percent slopes
EfA	Egan-Trent silty clay loams, 0 to 2 percent slopes (where flooded during the growing season once or less in 2 years)
EgB	Egan-Wentworth silty clay loams, 2 to 6 percent slopes
EnA	Enet loam, 0 to 2 percent slopes
HuA	Huntimer silty clay loam, 0 to 2 percent slopes
La	Lamo silty clay loam (where drained)
Ro	Roxbury silt loam
Rv	Roxbury Variant silt loam
WaA	Wakonda-Wentworth-Chancellor silty clay loams, 0 to 3 percent slopes (where drained and where flooded during the growing season once or less in 2 years)
WcA	Wentworth-Chancellor-Wakonda silty clay loams, 0 to 2 percent slopes (where drained and where flooded during the growing season once or less in 2 years)

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Only arable soils are listed. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Oats	Soybeans	Alfalfa hay	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*
Ac---- Alcester	92	91	38	4.2	7.0
Ar---- Arlo	60	49	20	3.2	5.3
Ba**---- Baltic	61	65	23	3.0	5.0
BkA---- Blendon	64	60	20	2.4	4.0
BmB---- Blendon-Henkin	60	55	19	2.2	3.6
Ca---- Chancellor	77	74	29	3.4	5.7
Cd, Ce---- Clamo	70	56	29	3.7	6.2
ChA---- Clarno-Bonilla	79	78	28	3.2	5.3
ChB---- Clarno-Bonilla	75	75	28	3.2	5.4
CkA---- Clarno-Crossplain-Davison	78	77	28	3.4	5.6
CmB---- Clarno-Davison	68	71	24	2.9	4.9
CoB---- Clarno-Ethan	67	71	25	3.1	5.1
CoC---- Clarno-Ethan	58	61	20	2.8	4.8
Cr---- Crossplain	77	74	29	3.4	5.7
DaA---- Davis	88	84	32	4.3	7.2
DaB---- Davis	85	83	30	3.9	6.5
DbA---- Davis	56	64	27	2.6	4.3
DeA---- Delmont-Enet	42	50	20	2.0	3.4
DeB---- Delmont-Enet	41	49	18	1.9	3.3
DgB---- Dempster-Graceville	67	70	28	3.3	4.7
Do---- Dimo	66	72	27	2.4	4.0

See footnotes at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Oats	Soybeans	Alfalfa hay	Bromegrass-alfalfa
	Bu	Bu	Bu	Ton	AUM*
EeA---- Egan-Ethan	80	80	29	3.4	5.6
EeB---- Egan-Ethan	73	75	26	3.3	5.5
EfA---- Egan-Trent	87	84	33	3.9	6.5
EgB---- Egan-Wentworth	81	81	29	3.5	5.9
EnA---- Enet	54	62	22	2.5	4.2
EtB---- Ethan-Egan	66	70	24	3.1	5.1
EtC---- Ethan-Egan	58	58	22	3.0	5.0
HuA---- Huntimer	78	76	28	3.0	5.0
La---- Lamo	70	74	32	3.9	6.5
Ro---- Roxbury	91	90	38	4.2	7.0
Rv---- Roxbury Variant	90	88	38	4.2	7.0
Sa---- Salmo	40	47	---	2.6	4.3
Te**---- Tetonka	61	65	23	3.0	5.0
WaA---- Wakonda-Wentworth-Chancellor	75	74	27	3.3	4.7
WcA---- Wentworth-Chancellor-Wakonda	80	79	32	3.7	6.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** Yields are for drained areas only.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils used primarily as rangeland are listed]

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Ba---------- Baltic	Shallow Marsh----------	Favorable	7,400	Rivergrass----------	40
		Normal	6,700	Sedge----------	40
		Unfavorable	5,400	Reedgrass----------	10
BeE*:					
Betts----------	Thin Upland----------	Favorable	3,100	Little bluestem----------	45
		Normal	2,600	Sideoats grama----------	10
		Unfavorable	1,800	Needleandthread----------	10
				Prairie dropseed----------	10
				Big bluestem----------	5
				Blue grama----------	5
				Sedge----------	5
				Leadplant----------	5
Ethan----------	Silty----------	Favorable	3,700	Little bluestem----------	40
		Normal	3,100	Needlegrass----------	30
		Unfavorable	2,200	Big bluestem----------	10
				Sideoats grama----------	5
				Blue grama----------	5
				Sedge----------	5
BhE*:					
Betts----------	Thin Upland----------	Favorable	3,100	Little bluestem----------	45
		Normal	2,600	Sideoats grama----------	10
		Unfavorable	1,800	Needleandthread----------	10
				Prairie dropseed----------	10
				Big bluestem----------	5
				Blue grama----------	5
				Sedge----------	5
				Leadplant----------	5
Talmo----------	Very Shallow----------	Favorable	2,500	Blue grama----------	35
		Normal	2,100	Needleandthread----------	30
		Unfavorable	1,300	Sideoats grama----------	15
				Sedge----------	10
BkA---------- Blendon	Sandy----------	Favorable	4,300	Little bluestem----------	25
		Normal	3,600	Big bluestem----------	20
		Unfavorable	2,600	Prairie sandreed----------	15
				Needleandthread----------	10
				Porcupinegrass----------	10
				Blue grama----------	5
				Leadplant----------	5
				Sedge----------	5
BmB*:					
Blendon----------	Sandy----------	Favorable	4,300	Little bluestem----------	25
		Normal	3,600	Big bluestem----------	20
		Unfavorable	2,600	Prairie sandreed----------	15
				Needleandthread----------	10
				Porcupinegrass----------	10
				Blue grama----------	5
				Leadplant----------	5
				Sedge----------	5
Henkin----------	Sandy----------	Favorable	4,200	Big bluestem----------	25
		Normal	3,500	Little bluestem----------	20
		Unfavorable	2,400	Prairie sandreed----------	15
				Needleandthread----------	10
				Porcupinegrass----------	10
				Blue grama----------	5
				Leadplant----------	5
				Sedge----------	5

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Cc---------- Chaska	Subirrigated----------	Favorable	5,500	Big bluestem----------	60
		Normal	5,000	Indiangrass----------	15
		Unfavorable	4,000	Switchgrass----------	10
				Sedge----------	10
CoC*:					
Clarno----------	Silty----------	Favorable	4,600	Little bluestem----------	30
		Normal	3,800	Needlegrass----------	30
		Unfavorable	2,700	Big bluestem----------	20
				Sideoats grama----------	5
				Blue grama----------	5
				Sedge----------	5
Ethan----------	Silty----------	Favorable	3,900	Little bluestem----------	35
		Normal	3,300	Needlegrass----------	25
		Unfavorable	2,300	Big bluestem----------	20
				Sideoats grama----------	5
				Blue grama----------	5
				Sedge----------	5
DeA*, DeB*:					
Delmont----------	Shallow to Gravel----------	Favorable	3,300	Needleandthread----------	50
		Normal	2,800	Little bluestem----------	10
		Unfavorable	1,700	Sedge----------	10
				Sideoats grama----------	5
				Prairie dropseed----------	5
				Blue grama----------	5
				Plains muhly----------	5
Enet----------	Silty----------	Favorable	4,600	Big bluestem----------	30
		Normal	3,800	Little bluestem----------	30
		Unfavorable	2,700	Needlegrass----------	20
				Sideoats grama----------	5
				Blue grama----------	5
				Sedge----------	5
EsD*:					
Ethan----------	Silty----------	Favorable	3,700	Little bluestem----------	40
		Normal	3,100	Needlegrass----------	30
		Unfavorable	2,200	Big bluestem----------	10
				Sideoats grama----------	5
				Blue grama----------	5
				Sedge----------	5
Betts----------	Thin Upland----------	Favorable	3,100	Little bluestem----------	45
		Normal	2,600	Sideoats grama----------	10
		Unfavorable	1,800	Needleandthread----------	10
				Prairie dropseed----------	10
				Big bluestem----------	5
				Blue grama----------	5
				Sedge----------	5
				Leadplant----------	5
EtC*:					
Ethan----------	Silty----------	Favorable	3,900	Little bluestem----------	35
		Normal	3,300	Needlegrass----------	25
		Unfavorable	2,300	Big bluestem----------	20
				Sideoats grama----------	5
				Blue grama----------	5
				Sedge----------	5
Egan----------	Silty----------	Favorable	4,600	Big bluestem----------	30
		Normal	3,800	Little bluestem----------	30
		Unfavorable	2,700	Needlegrass----------	20
				Sideoats grama----------	5
				Blue grama----------	5
				Sedge----------	5

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Sa Salmo	Subirrigated	Favorable Normal Unfavorable	6,000 5,500 4,400	Big bluestem Little bluestem Western wheatgrass Cordgrass Nuttall alkaligrass Switchgrass	50 20 10 5 5 5
Te Tetonka	Wet Meadow	Favorable Normal Unfavorable	5,300 4,800 3,400	Sedge Reedgrass Prairie cordgrass Western wheatgrass Bluegrass	50 20 10 5 5
Wo Worthing	Shallow Marsh	Favorable Normal Unfavorable	7,500 6,800 5,400	Rivergrass Slough sedge Reedgrass Prairie cordgrass	40 30 10 5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ac Alcester	---	Siberian peashrub, American plum, lilac.	Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar.	Golden willow, green ash, hackberry.	Eastern cottonwood, Siberian elm.
Ar Arlo	Silver buffaloberry, lilac.	Siberian peashrub, Tatarian honeysuckle.	Hackberry, blue spruce, ponderosa pine, Siberian crabapple, eastern redcedar.	Golden willow, green ash.	Eastern cottonwood.
Ba* Baltic	Lilac	Siberian peashrub, Tatarian honeysuckle.	Hackberry, blue spruce, ponderosa pine, Manchurian crabapple, eastern redcedar.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
Bb. Baltic					
BeE**: Betts.					
Ethan.					
BhE**: Betts.					
Talmo.					
BkA Blendon	Skunkbush sumac	Tatarian honeysuckle, Siberian peashrub, lilac, American plum.	Honeylocust, green ash, hackberry, ponderosa pine, Russian-olive, eastern redcedar.	---	Siberian elm.
BmB**: Blendon	Skunkbush sumac	Tatarian honeysuckle, Siberian peashrub, lilac, American plum.	Honeylocust, green ash, hackberry, ponderosa pine, Russian-olive, eastern redcedar.	---	Siberian elm.
Henkin	---	Eastern redcedar, Tatarian honeysuckle, Siberian peashrub, lilac, American plum.	Green ash, hackberry, ponderosa pine, Russian-olive, Siberian crabapple.	Siberian elm, honeylocust.	---
Ca Chancellor	Silver buffaloberry, lilac.	Siberian peashrub, Tatarian honeysuckle.	Hackberry, blue spruce, ponderosa pine, Siberian crabapple, eastern redcedar.	Golden willow, green ash.	Eastern cottonwood.

See footnotes at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Cc---------- Chaska	Lilac, silver buffaloberry.	Tatarian honeysuckle, Siberian peashrub.	Ponderosa pine, Siberian crabapple, eastern redcedar, Black Hills spruce, hackberry.	Golden willow, green ash.	Eastern cottonwood.
Cd, Ce---------- Clamo	Silver buffaloberry, lilac.	Siberian peashrub, Tatarian honeysuckle.	Hackberry, blue spruce, ponderosa pine, Siberian crabapple, eastern redcedar.	Golden willow, green ash.	Eastern cottonwood.
ChA**, ChB**: Clarno----------	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackberry, blue spruce, ponderosa pine, Russian-olive, Siberian crabapple.	Honeylocust, green ash.	Siberian elm.
Bonilla----------	---	Siberian peashrub, American plum, lilac.	Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar.	Golden willow, green ash, hackberry.	Eastern cottonwood, Siberian elm.
CkA**: Clarno----------	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackberry, blue spruce, ponderosa pine, Russian-olive, Siberian crabapple.	Honeylocust, green ash.	Siberian elm.
Crossplain-------	Silver buffaloberry, lilac.	Siberian peashrub, Tatarian honeysuckle.	Hackberry, blue spruce, ponderosa pine, Siberian crabapple, eastern redcedar.	Golden willow, green ash.	Eastern cottonwood.
Davison----------	---	Siberian peashrub, American plum, lilac, eastern redcedar.	Ponderosa pine, blue spruce, Siberian crabapple, hackberry, Russian-olive.	Honeylocust, green ash.	Siberian elm.
CmB**: Clarno----------	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackberry, blue spruce, ponderosa pine, Russian-olive, Siberian crabapple.	Honeylocust, green ash.	Siberian elm.

See footnotes at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
CmB**: Davison	---	Siberian peashrub, American plum, lilac, eastern redcedar.	Hackberry, ponderosa pine, blue spruce, Siberian crabapple, Russian-olive.	Honeylocust, green ash.	Siberian elm.
CoB**, CoC**: Clarno	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackberry, blue spruce, ponderosa pine, Russian-olive, Siberian crabapple.	Honeylocust, green ash.	Siberian elm.
Ethan	American plum, silver buffaloberry.	Russian-olive, hackberry, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, Tatarian honeysuckle.	Siberian elm, honeylocust, green ash, ponderosa pine.	---	---
Cr Crossplain	Silver buffaloberry, lilac.	Siberian peashrub, Tatarian honeysuckle.	Hackberry, blue spruce, ponderosa pine, Siberian crabapple, eastern redcedar.	Golden willow, green ash.	Eastern cottonwood.
DaA, DaB, DbA Davis	---	Siberian peashrub, American plum, lilac.	Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar.	Golden willow, green ash, hackberry.	Eastern cottonwood, Siberian elm.
DeA**, DeB**: Delmont	Tatarian honeysuckle, Peking cotoneaster, lilac.	Siberian crabapple, eastern redcedar, Rocky Mountain juniper, Siberian peashrub.	Honeylocust, green ash, Russian-olive, ponderosa pine.	Siberian elm------	---
Enet	Tatarian honeysuckle, Peking cotoneaster, lilac.	Siberian crabapple, eastern redcedar, Rocky Mountain juniper, Siberian peashrub.	Honeylocust, green ash, Russian-olive, ponderosa pine.	Siberian elm------	---
DgB**: Dempster	Lilac----------	Siberian crabapple, common chokecherry, Russian-olive, eastern redcedar, Siberian peashrub, Tatarian honeysuckle, Rocky Mountain juniper.	Ponderosa pine, green ash, honeylocust.	Siberian elm------	---

See footnotes at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
DgB**: Graceville	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Russian-olive, hackberry, ponderosa pine, blue spruce, Siberian crabapple.	Honeylocust, green ash.	Siberian elm.
Do Dimo	---	Siberian peashrub, American plum, lilac.	Blue spruce, ponderosa pine, Siberian crabapple, eastern redcedar.	Green ash, hackberry, golden willow.	Eastern cottonwood, Siberian elm.
EeA**: Egan	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackberry, blue spruce, ponderosa pine, Russian-olive, Siberian crabapple.	Honeylocust, green ash.	Siberian elm.
Ethan	American plum, silver buffaloberry.	Russian-olive, hackberry, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, Tatarian honeysuckle.	Siberian elm, honeylocust, green ash, ponderosa pine.	---	---
EeB**: Egan	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackbery, blue spruce, ponderosa pine, Russian-olive, Siberian crabapple.	Honeylocust, green ash.	Siberian elm.
Ethan	American plum, silver buffaloberry.	Russian-olive, hackberry, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, Tatarian honeysuckle.	Siberian elm, honeylocust, green ash, ponderosa pine.	---	---
EfA**: Egan	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackberry, blue spruce, ponderosa pine, Russian-olive, Siberian crabapple.	Honeylocust, green ash.	Siberian elm.
Trent	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Ponderosa pine, blue spruce, Siberian crabapple.	Golden willow, green ash, hackberry.	Eastern cottonwood, Siberian elm.
EgB**: Egan	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackberry, blue spruce, ponderosa pine, Russian-olive, Siberian crabapple.	Honeylocust, green ash.	Siberian elm.

See footnotes at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
EgB**: Wentworth	---	Eastern redcedar, Siberian peashrub, lilac.	Hackberry, blue spruce, ponderosa pine, Siberian crabapple.	Honeylocust, green ash.	Siberian elm.
EnA Enet	Tatarian honeysuckle, Peking cotoneaster, lilac.	Siberian crabapple, eastern redcedar, Rocky Mountain juniper, Siberian peashrub.	Honeylocust, green ash, Russian-olive, ponderosa pine.	Siberian elm	---
EsD**: Ethan.					
Betts.					
EtB**, EtC**: Ethan	American plum, silver buffaloberry.	Russian-olive, hackberry, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, Tatarian honeysuckle.	Siberian elm, honeylocust, green ash, ponderosa pine.	---	---
Egan	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackberry, blue spruce, ponderosa pine, Russian-olive, Siberian crabapple.	Honeylocust, green ash.	Siberian elm.
HuA Huntimer	---	Eastern redcedar, Siberian crabapple, American plum, Siberian peashrub, Tatarian honeysuckle, lilac.	Ponderosa pine, Russian-olive, honeylocust.	Green ash, hackberry, Siberian elm.	---
La Lamo	Lilac	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, ponderosa pine, hackbery, green ash, Manchurian crabapple.	Honeylocust, golden willow.	Eastern cottonwood.
Or**: Orthents.					
Aquents.					
Ro Roxbury	---	Tatarian honeysuckle, Siberian peashrub, silver buffaloberry.	Eastern redcedar, Russian-olive, ponderosa pine, green ash, Russian mulberry.	Siberian elm, hackberry, honeylocust.	Eastern cottonwood.
Rv Roxbury Variant	---	Siberian peashrub, American plum, lilac.	Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar.	Golden willow, green ash, hackberry.	Eastern cottonwood, Siberian elm.

See footnotes at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Sa. Salmo					
Te*---------- Tetonka	Silver buffaloberry, lilac.	Siberian peashrub, Tatarian honeysuckle.	Hackberry, blue spruce, ponderosa pine, Siberian crabapple, eastern redcedar.	Golden willow, green ash.	Eastern cottonwood.
WaA**: Wakonda----------	---	Siberian peashrub, American plum, lilac, eastern redcedar.	Hackberry, ponderosa pine, blue spruce, Siberian crabapple, Russian-olive.	Honeylocust, green ash.	Siberian elm.
Wentworth--------	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackberry, blue spruce, ponderosa pine, Russian-olive, Siberian crabapple.	Honeylocust, green ash.	Siberian elm.
Chancellor-------	Silver buffaloberry, lilac.	Siberian peashrub, Tatarian honeysuckle.	Hackberry, blue spruce, ponderosa pine, Siberian crabapple, eastern redcedar.	Golden willow, green ash.	Eastern cottonwood.
WcA**: Wentworth--------	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackberry, blue spruce, ponderosa pine, Russian-olive, Siberian crabapple.	Honeylocust, green ash.	Siberian elm.
Chancellor-------	Silver buffaloberry, lilac.	Siberian peashrub, Tatarian honeysuckle.	Hackberry, blue spruce, ponderosa pine, Siberian crabapple, eastern redcedar.	Golden willow, green ash.	Eastern cottonwood.
Wakonda----------	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackberry, ponderosa pine, blue spruce, Siberian crabapple, Russian-olive.	Honeylocust, green ash.	Siberian elm.
Wo*---------- Worthing	Silver buffaloberry, lilac.	Siberian peashrub, Tatarian honeysuckle.	Hackberry, blue spruce, ponderosa pine, Siberian crabapple, eastern redcedar.	Golden willow, green ash.	Eastern cottonwood.

* Trees and shrubs should be planted only in drained areas.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Ac---------- Alcester	Good	Good	Fair	Good	Poor	Very poor.	Very poor.	Good	Very poor.	Very poor.	Fair.
Ar---------- Arlo	Fair	Poor	Fair	Good	Very poor.	Fair	Fair	Fair	Very poor.	Fair	Fair.
Ba---------- Baltic	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Fair	Very poor.	Fair	Fair.
Bb---------- Baltic	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good	Very poor.
BeE*:											
Betts----------	Very poor.	Very poor.	Fair	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Fair.
Ethan----------	Very poor.	Fair	Good	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good.
BhE*:											
Betts----------	Very poor.	Very poor.	Fair	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Fair.
Talmo----------	Very poor.	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Poor.
BkA---------- Blendon	Fair	Fair	Good	Fair	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.
BmB*:											
Blendon----------	Fair	Fair	Good	Fair	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.
Henkin----------	Fair	Fair	Good	Fair	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.
Ca---------- Chancellor	Good	Good	Fair	Good	Very poor.	Poor	Poor	Good	Very poor.	Poor	Fair.
Cc---------- Chaska	Very poor.	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair.
Cd, Ce---------- Clamo	Good	Good	Fair	Good	Very poor.	Fair	Fair	Good	Very poor.	Fair	Fair.
ChA*, ChB*:											
Clarno----------	Good	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
Bonilla----------	Good	Good	Fair	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Fair.
CkA*:											
Clarno----------	Good	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
Crossplain--------	Good	Good	Fair	Good	Very poor.	Poor	Poor	Good	Very poor.	Poor	Fair.
Davison----------	Good	Good	Good	Good	Very poor.	Poor	Poor	Good	Very poor.	Poor	Good.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
CmB*:											
Clarno	Good	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
Davison	Fair	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
CoB*:											
Clarno	Good	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
Ethan	Fair	Fair	Good	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.
CoC*:											
Clarno	Fair	Good	Good	Fair	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.
Ethan	Poor	Fair	Good	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Good.
Cr Crossplain	Good	Good	Fair	Good	Very poor.	Poor	Poor	Good	Very poor.	Poor	Fair.
DaA Davis	Good	Good	Fair	Good	Poor	Very poor.	Very poor.	Good	Poor	Very poor.	Fair.
DaB, DbA Davis	Good	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
DeA*:											
Delmont	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Poor.
Enet	Good	Fair	Good	Poor	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
DeB*:											
Delmont	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Poor.
Enet	Fair	Fair	Good	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.
DgB*:											
Dempster	Fair	Fair	Good	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.
Graceville	Good	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
Do Dimo	Good	Good	Fair	Good	Poor	Very poor.	Very poor.	Good	Poor	Very poor.	Fair.
EeA*:											
Egan	Good	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
Ethan	Fair	Fair	Good	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.
EeB*:											
Egan	Good	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
Ethan	Fair	Fair	Good	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
EfA*:											
Egan	Good	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
Trent	Good	Good	Fair	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Fair.
EgB*:											
Egan	Good	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
Wentworth	Good	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
EnA Enet	Good	Fair	Good	Poor	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
EsD*:											
Ethan	Very poor.	Fair	Good	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good.
Betts	Very poor.	Poor	Fair	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Fair.
EtB*:											
Ethan	Fair	Fair	Good	Poor	Very poor.	Very poor.	Very poor.	Fair	Very poor.	Very poor.	Good.
Egan	Good	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
EtC*:											
Ethan	Poor	Fair	Good	Poor	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.	Good.
Egan	Fair	Good	Good	Fair	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
HuA Huntimer	Good	Fair	Good	Fair	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
La Lamo	Good	Good	Fair	Good	Good	Fair	Fair	Good	Fair	Fair	Fair.
Or*:											
Orthents.											
Aquents.											
Ro Roxbury	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair	Poor	Fair.
Rv Roxbury Variant	Good	Good	Fair	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Fair.
Sa Salmo	Poor	Poor	Fair	Poor	Very poor.	Fair	Fair	Poor	Very poor.	Fair	Fair.
Te Tetonka	Poor	Poor	Fair	Poor	Very poor.	Fair	Fair	Poor	Very poor.	Fair	Fair.
WaA*:											
Wakonda	Good	Good	Good	Good	Very poor.	Poor	Poor	Good	Very poor.	Poor	Good.
Wentworth	Good	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
WaA*:											
Chancellor	Good	Good	Fair	Good	Very poor.	Poor	Poor	Good	Very poor.	Poor	Fair.
WcA*:											
Wentworth	Good	Good	Good	Good	Very poor.	Very poor.	Very poor.	Good	Very poor.	Very poor.	Good.
Chancellor	Good	Good	Fair	Good	Very poor.	Poor	Poor	Good	Very poor.	Poor	Fair.
Wakonda	Good	Good	Good	Good	Very poor.	Poor	Poor	Good	Very poor.	Poor	Good.
Wo----------Worthing	Very poor.	Poor	Fair	Poor	Very poor.	Good	Good	Very poor.	Poor	Good	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ac Alcester	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.
Ar Arlo	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.
Ba, Bb Baltic	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.
BeE*:					
Betts	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Ethan	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
BhE*:					
Betts	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Talmo	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
BkA Blendon	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
BmB*:					
Blendon	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.
Henkin	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.
Ca Chancellor	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, flooding, wetness.
Cc Chaska	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.
Cd Clamo	Severe: wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: low strength, wetness, flooding.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ce Clamo	Severe: cutbanks cave, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, flooding.
ChA*: Clarno	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Bonilla	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, low strength.
ChB*: Clarno	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength.
Bonilla	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, low strength.
CkA*: Clarno	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Crossplain	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, flooding, frost action.
Davison	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.
CmB*: Clarno	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Davison	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action.
CoB*, CoC*: Clarno	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength.
Ethan	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength.
Cr Crossplain	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, flooding, frost action.
DaA Davis	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, low strength.
DaB Davis	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength.
DbA Davis	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
DeA*:					
Delmont	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Enet	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
DeB*:					
Delmont	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Enet	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
DgB*:					
Dempster	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength, frost action.
Graceville	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.
Do Dimo	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding, frost action.
EeA*:					
Egan	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.
Ethan	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
EeB*:					
Egan	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.
Ethan	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength.
EfA*:					
Egan	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.
Trent	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.
EgB*:					
Egan	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.
Wentworth	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.
EnA Enet	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
EsD*:					
Ethan	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Severe: low strength.
Betts	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Severe: low strength.
EtB*, EtC*:					
Ethan	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength.
Egan	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.
HuA	Moderate: too clayey.	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Huntimer					
La	Severe: wetness.	Severe: flooding, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, frost action.
Lamo					
Or*:					
Orthents.					
Aquents.					
Ro	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Roxbury					
Rv	Moderate: too clayey, wetness, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.
Roxbury Variant					
Sa	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.
Salmo					
Te	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: shrink-swell, ponding.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.
Tetonka					
WaA*:					
Wakonda	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.
Wentworth	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.
Chancellor	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, flooding, wetness.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
WcA*:					
Wentworth	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.
Chancellor	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, flooding, wetness.
Wakonda	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength, frost action.
Wo	Severe: ponding.	Severe: shrink-swell, ponding.	Severe: shrink-swell, ponding.	Severe: shrink-swell, ponding.	Severe: low strength, ponding, frost action.
Worthing					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ac Alcester	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
Ar Arlo	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: too sandy, small stones, wetness.
Ba, Bb Baltic	Severe: ponding, percs slowly.	Slight	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
BeE*: Betts	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Ethan	Severe: slope, percs slowly.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
BhE*: Betts	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Talmo	Severe: slope, poor filter.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
BkA Blendon	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
BmB*: Blendon	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
Henkin	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
Ca Chancellor	Severe: flooding, wetness, percs slowly.	Slight	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
Cc Chaska	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness, thin layer.
Cd Clamo	Severe: flooding, percs slowly, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, wetness, hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ce Clamo	Severe: flooding, wetness, percs slowly.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
ChA*: Clarno	Severe: percs slowly.	Slight	Slight	Slight	Good.
Bonilla	Severe: flooding, percs slowly, wetness.	Moderate: seepage.	Severe: flooding.	Severe: flooding.	Fair: too clayey, wetness.
ChB*: Clarno	Severe percs slowly.	Moderate: slope, seepage.	Slight	Slight	Good.
Bonilla	Severe: flooding, percs slowly, wetness.	Moderate: seepage.	Severe: flooding.	Severe: flooding.	Fair: too clayey, wetness.
CkA*: Clarno	Severe: percs slowly, wetness.	Severe: wetness.	Moderate: wetness.	Slight	Moderate: wetness.
Crossplain	Severe: flooding, wetness, percs slowly.	Slight	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
Davison	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Fair: wetness.
CmB*: Clarno	Severe: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Good.
Davison	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Fair: wetness.
CoB*: Clarno	Severe: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Good.
Ethan	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Good.
CoC*: Clarno	Severe: percs slowly.	Severe: slope.	Slight	Slight	Good.
Ethan	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Good.
Cr Crossplain	Severe: flooding, wetness, percs slowly.	Slight	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
DaA---------- Davis	Severe: flooding.	Moderate: seepage.	Severe: flooding.	Severe: flooding.	Good.
DaB---------- Davis	Moderate: percs slowly.	Moderate: slope, seepage.	Slight----------	Slight----------	Good.
DbA---------- Davis	Severe: poor filter.	Severe: seepage, flooding.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
DeA*, DeB*: Delmont----------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: small stones, seepage, too sandy.
Enet----------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
DgB*: Dempster----------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Graceville---------	Slight----------	Severe: seepage.	Severe: seepage.	Slight----------	Fair: too clayey, thin layer.
Do---------- Dimo	Severe: flooding, wetness, poor filter.	Severe: seepage, wetness, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: too sandy, seepage, small stones.
EeA*: Egan----------	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight----------	Poor: hard to pack.
Ethan----------	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight----------	Good.
EeB*: Egan----------	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Poor: hard to pack.
Ethan----------	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight----------	Good.
EfA*: Egan----------	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight----------	Poor: hard to pack.
Trent----------	Severe: flooding, wetness.	Moderate: seepage.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
EgB*: Egan----------	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Poor: hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
EgB*:					
Wentworth	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
EnA	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Enet					
EsD*:					
Ethan	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: slope.
Betts	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
EtB*:					
Ethan	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Good.
Egan	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Poor: hard to pack.
EtC*:					
Ethan	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Good.
Egan	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Poor: hard to pack.
HuA	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Poor: hard to pack.
Huntimer					
La	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack.
Lamo					
Or*:					
Orthents.					
Aquents.					
Ro	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Roxbury					
Rv	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
Roxbury Variant					
Sa	Severe: flooding, wetness, percs slowly.	Slight	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
Salmo					
Te	Severe: percs slowly, ponding.	Slight	Severe: ponding, too clayey.	Severe: ponding.	Poor: ponding, too clayey, hard to pack.
Tetonka					

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Cohtinued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
WaA*:					
Wakonda	Severe: wetness, percs slowly.	Slight	Severe: wetness.	Moderate: wetness.	Fair: too clayey, wetness.
Wentworth	Severe: wetness, percs slowly.	Moderate: seepage, wetness.	Moderate: wetness, too clayey.	Slight	Fair: too clayey.
Chancellor	Severe: flooding, wetness, percs slowly.	Slight	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
WcA*:					
Wentworth	Severe: wetness, percs slowly.	Moderate: seepage, wetness.	Moderate: wetness, too clayey.	Slight	Fair: too clayey.
Chancellor	Severe: flooding, wetness, percs slowly.	Slight	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
Wakonda	Severe: wetness, percs slowly.	Slight	Severe: wetness.	Moderate: wetness.	Fair: too clayey, wetness.
Wo Worthing	Severe: percs slowly, ponding.	Slight	Severe: too clayey, ponding.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ac Alcester	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ar Arlo	Poor: wetness.	Probable	Probable	Poor: area reclaim, wetness.
Ba, Bb Baltic	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
BeE*: Betts	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Ethan	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
BhE*: Betts	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Talmo	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
BkA Blendon	Good	Probable	Improbable: too sandy.	Good.
BmB*: Blendon	Good	Probable	Improbable: too sandy.	Good.
Henkin	Good	Probable	Improbable: too sandy.	Good.
Ca Chancellor	Poor: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Cc Chaska	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Cd Clamo	Poor: wetness, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
Ce Clamo	Poor: wetness.	Probable	Probable	Poor: too clayey, wetness.
ChA*, ChB*: Clarno	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
ChA*, ChB*:				
Bonilla	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
CkA*:				
Clarno	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Crossplain	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Davison	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
CmB*:				
Clarno	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Davison	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
CoB*, CoC*:				
Clarno	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Ethan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Cr	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Crossplain				
DaA, DaB	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Davis				
DbA	Good	Probable	Probable	Poor: area reclaim.
Davis				
DeA*, DeB*:				
Delmont	Good	Probable	Probable	Poor: small stones, area reclaim.
Enet	Good	Probable	Probable	Poor: small stones, area reclaim.
DgB*:				
Dempster	Good	Probable	Probable	Poor: area reclaim.
Graceville	Good	Probable	Probable	Good.
Do	Fair: wetness.	Probable	Probable	Fair: thin layer, small stones.
Dimo				
EeA*:				
Egan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Ethan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
EeB*:				
Egan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Ethan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
EfA*:				
Egan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Trent	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
EgB*:				
Egan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Wentworth	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
EnA Enet	Good	Probable	Probable	Poor: small stones, area reclaim.
EsD*:				
Ethan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
Betts	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
EtB*, EtC*:				
Ethan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Egan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
HuA Huntimer	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
La Lamo	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Or*:				
Orthents.				
Aquents.				
Ro Roxbury	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Rv Roxbury Variant	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Sa Salmo	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness.
Te Tetonka	Poor: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, thin layer.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
WaA*:				
Wakonda	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Wentworth	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Chancellor	Poor: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
WcA*:				
Wentworth	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Chancellor	Poor: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Wakonda	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Wo--- Worthing	Poor: low strength, shrink-swell, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ac---------- Alcester	Moderate: seepage.	Severe: piping.	Deep to water	Flooding-------	Erodes easily	Erodes easily.
Ar---------- Arlo	Severe: seepage.	Severe: wetness, seepage.	Flooding, frost action, cutbanks cave.	Wetness, flooding.	Wetness, too sandy.	Wetness.
Ba, Bb---------- Baltic	Slight---------	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
BeE*: Betts----------	Severe: slope.	Slight---------	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Ethan----------	Severe: slope.	Slight---------	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
BhE*: Betts----------	Severe: slope.	Slight---------	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Talmo----------	Severe: seepage, slope.	Severe: seepage.	Deep to water	Droughty, slope.	Slope, too sandy.	Slope, droughty.
BkA---------- Blendon	Severe: seepage.	Severe: seepage, piping.	Deep to water	Soil blowing---	Too sandy, soil blowing.	Favorable.
BmB*: Blendon----------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
Henkin----------	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, slope.	Soil blowing---	Favorable.
Ca---------- Chancellor	Slight---------	Severe: hard to pack.	Percs slowly, flooding, frost action.	Wetness, percs slowly, flooding.	Wetness, percs slowly.	Wetness, percs slowly.
Cc---------- Chaska	Severe: seepage.	Severe: piping, wetness.	Flooding, frost action, cutbanks cave.	Wetness, flooding.	Wetness--------	Wetness.
Cd---------- Clamo	Slight---------	Severe: wetness, hard to pack.	Percs slowly, frost action, flooding.	Percs slowly, slow intake, wetness.	Percs slowly, wetness.	Wetness, percs slowly.
Ce---------- Clamo	Moderate: seepage.	Severe: hard to pack, wetness.	Percs slowly, flooding, frost action.	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
ChA*: Clarno----------	Moderate: seepage.	Slight---------	Deep to water	Favorable------	Erodes easily	Erodes easily.
Bonilla----------	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding-------	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
ChB*:						
Clarno	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
Bonilla	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding	Erodes easily	Erodes easily.
CkA*:						
Clarno	Moderate: seepage.	Slight	Deep to water	Favorable	Erodes easily	Erodes easily.
Crossplain	Slight	Severe: wetness.	Percs slowly, flooding, frost action.	Wetness, percs slowly, flooding.	Wetness, percs slowly.	Wetness, percs slowly.
Davison	Moderate: seepage.	Severe: piping.	Frost action	Wetness	Wetness, erodes easily.	Erodes easily.
CmB*:						
Clarno	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
Davison	Moderate: seepage, slope.	Severe: piping.	Frost action, slope.	Wetness, slope.	Wetness, erodes easily.	Erodes easily.
CoB*, CoC*:						
Clarno	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
Ethan	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
Cr Crossplain	Slight	Severe: wetness.	Percs slowly, flooding, frost action.	Wetness, percs slowly, flooding.	Wetness, percs slowly.	Wetness, percs slowly.
DaA Davis	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding	Favorable	Favorable.
DaB Davis	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Favorable	Favorable.
DbA Davis	Severe: seepage.	Severe: seepage.	Deep to water	Rooting depth	Too sandy	Rooting depth.
DeA*:						
Delmont	Severe: seepage.	Severe: seepage.	Deep to water	Droughty	Too sandy	Droughty.
Enet	Severe: seepage.	Severe: seepage.	Deep to water	Favorable	Too sandy	Favorable.
DeB*:						
Delmont	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, slope.	Too sandy	Droughty.
Enet	Severe: seepage.	Severe: seepage.	Deep to water	Slope	Too sandy	Favorable.
DgB*:						
Dempster	Severe: seepage.	Severe: seepage.	Deep to water	Slope	Too sandy	Favorable.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
DgB*:						
Graceville	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable	Favorable	Favorable.
Do	Severe: seepage.	Severe: seepage.	Flooding, frost action, cutbanks cave.	Wetness, flooding.	Wetness, too sandy.	Favorable.
Dimo						
EeA*:						
Egan	Moderate: seepage.	Moderate: piping, hard to pack.	Deep to water	Favorable	Erodes easily	Erodes easily.
Ethan	Moderate: seepage.	Slight	Deep to water	Favorable	Erodes easily	Erodes easily.
EeB*:						
Egan	Moderate: seepage, slope.	Moderate: piping, hard to pack.	Deep to water	Favorable slope.	Erodes easily	Erodes easily.
Ethan	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
EfA*:						
Egan	Moderate: seepage.	Moderate: piping, hard to pack.	Deep to water	Favorable	Erodes easily	Erodes easily.
Trent	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding	Erodes easily	Erodes easily.
EgB*:						
Egan	Moderate: seepage, slope.	Moderate: piping, hard to pack.	Deep to water	Slope	Erodes easily	Erodes easily.
Wentworth	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
EnA	Severe: seepage.	Severe: seepage.	Deep to water	Favorable	Too sandy	Favorable.
Enet						
EsD*:						
Ethan	Severe: slope.	Slight	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Betts	Severe: slope.	Slight	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
EtB*, EtC*:						
Ethan	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
Egan	Moderate: seepage, slope.	Moderate: piping, hard to pack.	Deep to water	Slope	Erodes easily	Erodes easily.
HuA	Slight	Severe: hard to pack.	Deep to water	Percs slowly	Percs slowly	Percs slowly.
Huntimer						
La	Slight	Moderate: piping, hard to pack, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Favorable.
Lamo						

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Or*:						
Orthents.						
Aquents.						
Ro---------- Roxbury	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Flooding-------	Erodes easily	Erodes easily.
Rv---------- Roxbury Variant	Moderate: seepage.	Severe: hard to pack.	Deep to water	Percs slowly, flooding.	Percs slowly---	Percs slowly.
Sa---------- Salmo	Slight---------	Severe: wetness.	Percs slowly, flooding, frost action.	Wetness, flooding, excess salt.	Wetness, percs slowly.	Wetness, excess salt, percs slowly.
Te---------- Tetonka	Slight---------	Severe: ponding, hard to pack.	Percs slowly, ponding, frost action.	Percs slowly, ponding.	Ponding, percs slowly.	Wetness, percs slowly.
WaA*:						
Wakonda----------	Moderate: seepage.	Moderate: piping, wetness.	Frost action---	Wetness, excess salt.	Erodes easily, wetness.	Erodes easily.
Wentworth--------	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Chancellor-------	Slight---------	Severe: hard to pack.	Percs slowly, flooding, frost action.	Wetness, percs slowly, flooding.	Wetness, percs slowly.	Wetness, percs slowly.
WcA*:						
Wentworth--------	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Chancellor-------	Slight---------	Severe: hard to pack.	Percs slowly, flooding, frost action.	Wetness, percs slowly, flooding.	Wetness, percs slowly.	Wetness, percs slowly.
Wakonda----------	Moderate: seepage.	Moderate: piping, wetness.	Frost action---	Wetness, excess salt.	Erodes easily, wetness.	Erodes easily.
Wo---------- Worthing	Slight---------	Severe: hard to pack, ponding.	Ponding, frost action, percs slowly.	Ponding, percs slowly.	Ponding, percs slowly, erodes easily.	Wetness, percs slowly.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ac---------- Alcester	0-10	Silt loam--------	CL, CL-ML, ML	A-4, A-6	0	100	100	95-100	85-100	25-40	6-20
	10-38	Silty clay loam, silt loam.	CL, ML	A-6, A-7	0	100	100	95-100	90-100	35-50	10-25
	38-60	Silty clay loam, silt loam.	ML, CL	A-6, A-7	0	100	95-100	95-100	85-100	30-50	10-20
Ar---------- Arlo	0-11	Clay loam--------	CL, ML	A-6, A-7	0-5	95-100	90-100	70-100	60-95	35-50	10-25
	11-18	Loam, clay loam	ML, CL	A-4, A-6, A-7	0-5	95-100	90-100	70-100	55-80	30-45	5-20
	18-35	Loam, sandy clay loam, clay loam.	ML, CL, SC, SM	A-4, A-6, A-7	0-5	95-100	90-100	60-95	40-75	30-45	5-20
	35-60	Gravelly sand, loamy sand, gravelly loamy sand.	GM, SM, SM-SC, SP-SM	A-2, A-1, A-3	0-5	60-100	50-85	35-65	5-35	<27	NP
Ba---------- Baltic	0-12	Silty clay loam	CL, CH, MH	A-7	0	100	100	90-100	85-100	40-65	15-35
	12-32	Silty clay, clay, silty clay loam.	CH, MH	A-7	0	100	95-100	90-100	85-100	50-70	20-40
	32-60	Silty clay, silty clay loam, clay loam.	CL, CH, MH, ML	A-6, A-7	0	100	95-100	80-100	65-100	35-70	15-35
Bb---------- Baltic	0-18	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	85-100	35-50	15-25
	18-49	Silty clay, clay, silty clay loam.	CH, MH	A-7	0	100	95-100	90-100	85-100	50-70	20-40
	49-60	Silty clay, silty clay loam, clay loam.	CL, CH, MH, ML	A-6, A-7	0	100	95-100	80-100	65-95	35-70	15-35
BeE*:											
Betts----------	0-4	Loam----------	CL, CL-ML	A-4, A-6	0-5	90-100	80-100	75-100	60-75	20-38	5-15
	4-26	Loam, clay loam	CL	A-6, A-7	0-5	90-100	85-100	75-100	50-85	30-45	10-25
	26-60	Clay loam, loam	CL	A-6, A-7	0-5	90-100	85-100	75-100	50-85	30-45	10-25
Ethan----------	0-8	Loam----------	CL	A-4, A-6	0	95-100	90-100	80-95	55-80	30-40	8-15
	8-21	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-100	55-80	30-50	10-25
	21-60	Loam, clay loam	CL	A-4, A-6, A-7	0-5	90-100	85-100	75-100	50-95	28-45	8-20
BhE*:											
Betts----------	0-4	Loam----------	CL, CL-ML	A-4, A-6	0-5	90-100	80-100	75-100	60-75	20-38	5-15
	4-26	Loam, clay loam	CL	A-6, A-7	0-5	90-100	85-100	75-100	50-85	30-45	10-25
	26-60	Clay loam, loam	CL	A-6, A-7	0-5	90-100	85-100	75-100	50-85	30-45	10-25
Talmo----------	0-7	Gravelly loam----	SM, SC, ML, CL	A-4	0-5	90-100	60-80	50-75	35-60	25-40	3-15
	7-60	Gravelly sand, very gravelly sand, gravelly loamy sand.	GW, GM, SW, SM	A-2, A-1	0-10	40-95	30-65	15-35	0-35	<25	NP-5
BkA---------- Blendon	0-8	Fine sandy loam	SM	A-4	0	100	90-100	60-100	35-50	20-30	NP-5
	8-36	Fine sandy loam, sandy loam, loam.	SM, SC, ML, CL	A-4, A-2	0	100	85-100	60-100	20-60	20-33	NP-10
	36-60	Fine sandy loam, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-4	0	85-100	65-100	50-100	10-45	<30	NP-5

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
BmB*:											
Blendon	0-8	Fine sandy loam	SM	A-4	0	100	90-100	60-100	35-50	20-30	NP-5
	8-36	Fine sandy loam, sandy loam, loam.	SM, SC, ML, CL	A-4, A-2	0	100	85-100	60-100	20-60	20-33	NP-10
	36-60	Fine sandy loam, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-4	0	85-100	65-100	50-100	10-45	<30	NP-5
Henkin	0-7	Fine sandy loam	SM, SC, ML, CL	A-2, A-4	0-5	90-100	80-100	65-100	30-55	15-30	NP-10
	7-48	Loam, sandy loam, fine sandy loam.	SM, SC, ML, CL	A-2, A-4	0-5	90-100	80-100	65-100	15-55	15-30	NP-10
	48-60	Stratified fine sand to clay loam.	SM, SC	A-2, A-4, A-1, A-3	0-5	90-100	80-100	35-95	5-50	15-35	NP-10
Ca	0-18	Silty clay loam	CL, CH, MH, ML	A-6, A-7	0	100	100	95-100	85-100	35-55	15-25
Chancellor	18-44	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-30
	44-60	Silty clay loam, clay loam, loam.	CL, CH, ML, MH	A-6, A-7	0	100	100	85-100	70-100	35-55	15-25
Cc	0-9	Loam	OL, CL, ML	A-4, A-6	0	100	100	90-100	70-80	30-40	5-15
Chaska	9-40	Stratified silt loam to loamy fine sand.	CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	20-40	5-15
	40-60	Stratified silt loam to fine sand.	SM, ML	A-4	0	100	100	85-95	35-75	<35	NP-7
Cd	0-12	Silty clay	CL, CH, MH, ML	A-7	0	100	95-100	90-100	85-100	45-75	20-40
Clamo	12-60	Silty clay loam, silty clay.	CL, CH, MH, ML	A-7	0	100	95-100	90-100	80-100	45-75	20-40
Ce	0-11	Clay	CL, CH, MH, ML	A-7	0	100	95-100	90-100	60-85	45-75	20-40
Clamo	11-36	Clay, clay loam, silty clay.	CL, CH, MH, ML	A-7	0	100	95-100	90-100	60-95	45-75	20-40
	36-51	Clay loam, sandy clay loam.	CL, CH, SC	A-7	0	100	90-100	70-100	40-75	40-60	20-30
	51-60	Gravelly loamy sand, gravelly sand.	SM, SW-SM	A-1, A-2	0-5	60-95	40-70	35-60	5-35	<25	NP-3
ChA*:											
Clarno	0-8	Loam	CL, CL-ML, ML	A-4, A-6	0	100	95-100	85-100	55-90	25-40	5-20
	8-29	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-100	55-85	30-45	10-20
	29-60	Loam, clay loam	CL	A-6, A-7	0-5	90-100	90-100	80-100	50-80	30-45	10-20
Bonilla	0-12	Loam	CL-ML, CL	A-4, A-6, A-7	0	100	95-100	75-100	50-90	25-45	5-20
	12-32	Loam, clay loam	CL	A-6, A-7	0	100	95-100	85-100	60-90	30-50	10-25
	32-60	Loam, clay loam, silt loam.	CL	A-6, A-7	0-5	95-100	95-100	85-100	60-90	30-45	10-22
ChB*:											
Clarno	0-8	Loam	CL, CL-ML, ML	A-4, A-6	0	100	95-100	85-100	55-90	25-40	5-20
	8-27	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-100	55-85	30-45	10-20
	27-60	Loam, clay loam	CL	A-6, A-7	0-5	90-100	90-100	80-100	50-80	30-45	10-20
Bonilla	0-13	Loam	CL-ML, CL	A-4, A-6, A-7	0	100	95-100	75-100	50-90	25-45	5-20
	13-35	Loam, clay loam	CL	A-6, A-7	0	100	95-100	85-100	60-90	30-50	10-25
	35-60	Loam, clay loam, silt loam.	CL	A-6, A-7	0-5	95-100	95-100	85-100	60-90	30-45	10-22

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
CkA*:											
Clarno	0-9	Loam	CL, ML, CL-ML	A-4, A-6	0	100	95-100	85-100	55-90	25-40	3-20
	9-30	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-100	55-85	30-45	10-20
	30-60	Loam, clay loam	CL	A-6, A-7	0-5	90-100	90-100	80-100	50-80	30-45	10-20
Crossplain	0-9	Clay loam	CL	A-4, A-6	0	100	100	90-100	70-80	30-40	9-19
	9-38	Clay loam, clay	CL, CH	A-7	0	100	95-100	90-100	70-85	40-55	15-30
	38-60	Clay loam, loam	CL	A-6, A-7	0	95-100	95-100	85-100	60-80	30-45	10-25
Davison	0-10	Loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-95	60-75	25-40	5-20
	10-25	Loam, clay loam, sandy loam.	CL, CL-ML, SC, SM-SC	A-4, A-6	0	95-100	95-100	85-100	45-80	25-35	5-15
	25-60	Loam, clay loam	CL-ML, CL	A-4, A-6	0-5	95-100	95-100	85-100	60-80	25-40	5-20
CmB*:											
Clarno	0-8	Loam	CL, CL-ML, ML	A-4, A-6	0	100	95-100	85-100	55-90	25-40	5-20
	8-29	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-100	55-85	30-45	10-20
	29-60	Loam, clay loam	CL	A-6, A-7	0-5	90-100	90-100	80-100	50-80	30-45	10-20
Davison	0-10	Loam	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-95	60-75	25-40	5-20
	10-25	Loam, clay loam, sandy loam.	CL, CL-ML, SC, SM-SC	A-4, A-6	0	95-100	95-100	85-100	45-80	25-40	5-20
	25-60	Loam, clay loam	CL-ML, CL	A-4, A-6	0-5	95-100	95-100	85-100	55-80	25-40	5-20
CoB*:											
Clarno	0-8	Loam	CL, CL-ML, ML	A-4, A-6	0	100	95-100	85-100	55-90	25-40	5-20
	8-27	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-100	55-85	30-45	10-20
	27-60	Loam, clay loam	CL	A-6, A-7	0-5	90-100	90-100	80-100	50-80	30-45	10-20
Ethan	0-8	Loam	CL	A-4, A-6	0	95-100	90-100	80-95	55-80	30-40	8-15
	8-21	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-100	55-80	30-50	10-25
	21-60	Loam, clay loam	CL	A-4, A-6, A-7	0-5	90-100	85-100	75-100	50-95	28-45	8-20
CoC*:											
Clarno	0-8	Loam	CL, CL-ML, ML	A-4, A-6	0	100	95-100	85-100	55-90	25-40	5-20
	8-24	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-100	55-85	30-45	10-20
	24-60	Loam, clay loam	CL	A-6, A-7	0-5	90-100	90-100	80-100	50-80	30-45	10-20
Ethan	0-8	Loam	CL	A-4, A-6	0	95-100	90-100	80-95	55-80	30-40	8-15
	8-21	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-100	55-80	30-50	10-25
	21-60	Loam, clay loam	CL	A-4, A-6, A-7	0-5	90-100	85-100	75-100	50-95	28-45	8-20
Cr	0-16	Clay loam	CL	A-4, A-6	0	100	100	90-100	70-80	30-40	9-19
Crossplain	16-43	Clay loam, clay	CL, CH	A-7	0	100	95-100	90-100	70-85	40-55	15-30
	43-60	Clay loam, loam	CL	A-6, A-7	0	95-100	95-100	85-100	60-80	30-45	10-25
DaA	0-14	Loam, silt loam	CL, ML	A-4, A-6, A-7	0	100	90-100	80-100	60-85	30-45	5-20
Davis	14-48	Loam, silt loam, clay loam.	CL, ML	A-4, A-6, A-7	0	100	90-100	80-100	60-85	30-45	5-20
	48-60	Loam, clay loam, silt loam.	CL, ML	A-4, A-6, A-7	0	100	95-100	85-100	55-90	30-45	5-20
DaB	0-14	Loam, silt loam	CL, ML	A-6, A-7	0	100	90-100	80-100	60-85	30-45	5-20
Davis	14-38	Loam, silt loam, clay loam.	CL, ML	A-6, A-7	0	100	90-100	80-100	60-85	35-45	10-20
	38-60	Loam, clay loam, silt loam.	CL	A-6, A-7	0	100	95-100	85-100	55-90	30-45	10-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
DbA---------- Davis	0-10	Loam----------	CL	A-6, A-7	0	100	90-100	80-100	60-85	30-45	10-20
	10-30	Loam, silt loam, clay loam.	CL	A-6, A-7	0	100	90-100	80-100	60-85	30-45	10-20
	30-36	Sandy loam-------	SM, SM-SC, SC	A-4	0	95-100	90-100	75-95	35-50	20-30	5-10
	36-60	Gravelly loamy sand, gravelly sand.	SW, SW-SM, SM, SM-SC	A-1	0	60-95	45-75	10-50	0-15	<25	NP-5
DeA*, DeB*: Delmont---------	0-8	Loam----------	CL	A-6, A-4	0	90-100	90-100	80-95	60-75	28-40	8-20
	8-18	Loam, fine sandy loam, sandy loam.	SC, CL, CL-ML, SM-SC	A-4, A-6	0	80-100	70-100	50-100	35-70	20-40	5-18
	18-60	Gravelly sand, gravelly loamy sand.	SM, SW-SM, SM-SC, SW	A-1, A-2	0-5	60-100	40-85	15-50	3-30	<25	NP-5
Enet----------	0-8	Loam----------	ML, CL	A-4, A-6	0	90-100	85-100	70-95	55-80	30-40	5-15
	8-20	Loam, clay loam, sandy clay loam.	CL, ML, SC, SM	A-4, A-6	0	90-100	85-100	70-95	45-75	30-40	5-15
	20-24	Loam, fine sandy loam, sandy loam.	ML, CL, SM, SC	A-4, A-6	0	90-100	85-95	60-95	40-75	20-40	3-15
	24-60	Gravelly loamy sand, gravelly sand.	SW, SW-SM, SM, SM-SC	A-1, A-2, A-3	0	60-95	45-90	10-60	0-15	<25	NP-5
DgB*: Dempster--------	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	85-95	30-45	10-20
	8-26	Silty clay loam, silt loam.	CL, ML	A-6, A-7, A-4	0	100	100	90-100	75-95	30-45	7-20
	26-34	Loam, silt loam, clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	85-95	60-95	30-45	7-20
	34-60	Gravelly sand, gravelly loamy sand, very gravelly sand.	SM, SW, SW-SM, GP-GM	A-2, A-1, A-3	0	55-90	30-75	20-60	3-30	<25	NP-5
Graceville------	0-18	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	35-45	11-20
	18-52	Silty clay loam, silt loam.	CL	A-4, A-6, A-7	0	100	100	90-100	70-90	30-45	8-20
	52-60	Gravelly sand, gravelly loamy sand.	SM, GW-GM, SW-SM, GM	A-1, A-2	0	40-80	30-70	20-50	5-30	<25	NP-4
Do---------- Dimo	0-9	Clay loam--------	CL	A-6, A-7	0	100	100	85-95	70-80	35-45	12-20
	9-29	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	90-100	85-100	85-95	50-80	35-45	12-20
	29-60	Gravelly sand, gravelly loamy sand.	SM, SP-SM, SW-SM, SM-SC	A-1, A-2, A-3	0-5	60-100	40-90	20-60	5-30	<25	NP-5
EeA*, EeB*: Egan----------	0-8	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	8-30	Silty clay loam	CL, CH, ML, MH	A-6, A-7	0	100	95-100	90-100	80-100	35-55	10-30
	30-60	Clay loam, loam	CL, CH, ML, MH	A-6, A-7	0	95-100	80-100	70-100	60-85	30-55	10-25
Ethan----------	0-8	Loam----------	CL	A-4, A-6	0	95-100	90-100	80-95	55-80	30-40	8-15
	8-21	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-100	55-80	30-50	10-25
	21-60	Loam, clay loam	CL	A-4, A-6, A-7	0-5	90-100	85-100	75-100	50-95	28-45	8-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
EfA*:											
Egan	0-8	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	8-30	Silty clay loam	CL, CH, ML, MH	A-6, A-7	0	100	95-100	90-100	80-100	35-55	10-30
	30-60	Clay loam, loam	CL, CH, ML, MH	A-6, A-7	0	95-100	80-100	70-100	60-85	30-55	10-25
Trent	0-12	Silty clay loam	CL, CH, ML, MH	A-6, A-7	0	100	100	95-100	90-100	35-55	10-30
	12-38	Silty clay loam	CL, CH	A-6, A-7	0	100	95-100	90-100	80-100	35-55	15-30
	38-60	Silt loam, silty clay loam.	CL	A-6, A-7, A-4	0	100	90-100	85-100	70-100	30-50	8-25
EgB*:											
Egan	0-8	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	8-26	Silty clay loam	CL, CH, ML, MH	A-6, A-7	0	100	95-100	90-100	80-100	35-55	10-30
	26-60	Clay loam, loam	CL, CH, ML, MH	A-6, A-7	0	95-100	80-100	70-100	60-85	30-55	10-25
Wentworth	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	11-25
	8-26	Silty clay loam, silt loam.	CL, CH, MH	A-6, A-7	0	100	100	95-100	80-100	35-55	10-30
	26-36	Stratified silty clay loam to silt loam.	CL, ML	A-4, A-6, A-7	0	100	95-100	85-100	60-100	30-50	5-25
	36-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	90-100	85-100	55-85	30-50	10-25
EnA	0-8	Loam	ML, CL	A-4, A-6	0	90-100	85-100	70-95	55-80	30-40	5-15
Enet	8-25	Loam, clay loam, sandy clay loam.	CL, ML, SC, SM	A-4, A-6	0	90-100	85-100	70-95	45-75	30-40	5-15
	25-30	Loam, fine sandy loam, sandy loam.	ML, CL, SM, SC	A-4, A-6	0	90-100	85-95	60-95	40-75	20-40	3-15
	30-60	Gravelly loamy sand, gravelly sand.	SW, SW-SM, SM, SM-SC	A-1, A-2, A-3	0	60-95	45-90	10-60	0-15	<25	NP-5
EsD*:											
Ethan	0-8	Loam	CL	A-4, A-6	0	95-100	90-100	80-95	55-80	30-40	8-15
	8-21	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-100	55-80	30-50	10-25
	21-60	Loam, clay loam	CL	A-4, A-6, A-7	0-5	90-100	85-100	75-100	50-95	28-45	8-20
Betts	0-9	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	80-100	75-100	60-75	20-38	5-15
	9-26	Loam, clay loam	CL	A-6, A-7	0-5	90-100	85-100	75-100	50-85	30-45	10-25
	26-60	Clay loam, loam	CL	A-6, A-7	0-5	90-100	85-100	75-100	50-85	30-45	10-25
EtB*:											
Ethan	0-8	Loam	CL	A-4, A-6	0	95-100	90-100	80-95	55-80	30-40	8-15
	8-21	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-100	55-80	30-50	10-25
	21-60	Loam, clay loam	CL	A-4, A-6, A-7	0-5	90-100	85-100	75-100	50-95	28-45	8-20
Egan	0-9	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	9-22	Silty clay loam	CL, CH, ML, MH	A-6, A-7	0	100	95-100	90-100	80-100	35-55	10-30
	22-60	Clay loam, loam	CL, CH, ML, MH	A-6, A-7	0	95-100	80-100	70-100	60-85	30-55	10-25
EtC*:											
Ethan	0-8	Loam	CL	A-4, A-6	0	95-100	90-100	80-95	55-80	30-40	8-15
	8-21	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-100	55-80	30-50	10-25
	21-60	Loam, clay loam	CL	A-4, A-6, A-7	0-5	90-100	85-100	75-100	50-95	28-45	8-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
EtC*:											
Egan	0-8	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	8-23	Silty clay loam	CL, CH, ML, MH	A-6, A-7	0	100	95-100	90-100	80-100	35-55	10-30
	23-60	Clay loam, loam	CL, CH, ML, MH	A-6, A-7	0	95-100	80-100	70-100	60-85	30-55	10-25
HuA	0-8	Silty clay loam	CL, CH, MH, ML	A-7	0	100	100	95-100	90-100	45-70	20-35
Huntimer	8-20	Silty clay loam, silty clay.	CL, CH, MH, ML	A-7	0	100	100	95-100	90-100	45-70	20-35
	20-44	Silty clay loam, silty clay.	CL, CH, MH, ML	A-7	0	100	100	95-100	90-100	40-65	15-30
	44-60	Silty clay loam, silt loam.	CL, CH, MH	A-6, A-7	0	100	95-100	95-100	85-100	35-55	11-25
La	0-27	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	95-100	85-95	40-65	14-35
Lamo	27-60	Silty clay loam, silt loam.	CL, CH	A-7, A-6	0	100	100	95-100	85-95	30-55	11-35
Or*:											
Orthents.											
Aquents.											
Ro	0-20	Silt loam	CL	A-4, A-6	0	100	100	95-100	65-100	25-50	7-20
Roxbury	20-36	Silt loam, silty clay loam.	CL	A-4, A-6, A-7-6	0	100	100	95-100	80-100	30-50	8-25
	36-60	Silt loam, silty clay loam, loam.	ML, CL	A-4, A-6, A-7-6	0	100	100	95-100	65-100	30-50	7-25
Rv	0-8	Silt loam	CL	A-4, A-6, A-7	0	100	100	95-100	80-100	30-45	8-20
Roxbury Variant	8-24	Silt loam	CL	A-4, A-6, A-7	0	100	100	95-100	80-100	30-45	8-20
	24-45	Clay, silty clay	CH, MH	A-7	0	100	95-100	95-100	65-100	50-70	20-40
	45-60	Clay loam, clay, silty clay.	CL, CH	A-7	0	100	95-100	90-100	60-95	45-70	20-40
Sa	0-28	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	30-50	10-25
Salmo	28-36	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	85-95	30-45	10-20
	36-60	Silty clay loam, silty clay, clay loam.	CL, CH	A-7	0	100	95-100	90-100	75-95	40-60	15-35
Te	0-18	Silt loam	ML, CL	A-4, A-6, A-7	0	100	100	95-100	80-100	27-50	5-20
Tetonka	18-34	Clay, silty clay, clay loam.	CL, CH, MH, ML	A-7	0	95-100	95-100	85-100	65-100	40-70	15-35
	34-60	Clay loam, silty clay loam.	CL, CH	A-6, A-7	0	95-100	95-100	80-100	55-95	30-60	11-30
WaA*:											
Wakonda	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	85-100	30-50	10-25
	8-32	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	90-100	85-100	30-50	10-25
	32-60	Clay loam, loam	CL	A-6, A-7	0	95-100	95-100	85-95	60-80	35-50	11-25
Wentworth	0-9	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	11-25
	9-22	Silty clay loam, silt loam.	CL, CH, MH	A-6, A-7	0	100	100	95-100	80-100	35-55	10-30
	22-42	Stratified silty clay loam to silt loam.	CL, ML	A-4, A-6, A-7	0	100	95-100	85-100	60-100	30-50	5-25
	42-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	90-100	85-100	55-85	30-50	10-25

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
WaA*:											
Chancellor------	0-11	Silty clay loam	CL, CH, MH, ML	A-6, A-7	0	100	100	95-100	85-100	35-55	15-25
	11-36	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-30
	36-60	Silty clay loam, clay loam, loam.	CL, CH, ML, MH	A-6, A-7	0	100	100	85-100	70-100	35-55	15-25
WcA*:											
Wentworth-------	0-9	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	11-25
	9-22	Silty clay loam, silt loam.	CL, CH, MH	A-6, A-7	0	100	100	95-100	80-100	35-55	10-30
	22-42	Stratified silty clay loam to silt loam.	CL, ML	A-4, A-6, A-7	0	100	95-100	85-100	60-100	30-50	5-25
	42-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	90-100	85-100	55-85	30-50	10-25
Chancellor------	0-11	Silty clay loam	CL, CH, MH, ML	A-6, A-7	0	100	100	95-100	85-100	35-55	15-25
	11-36	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-30
	36-60	Silty clay loam, clay loam, loam.	CL, CH, ML, MH	A-6, A-7	0	100	100	85-100	70-100	35-55	15-25
Wakonda---------	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	85-100	30-50	10-25
	8-32	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	90-100	85-100	30-50	10-25
	32-60	Clay loam, loam	CL	A-6, A-7	0	95-100	95-100	85-95	60-80	35-50	11-25
Wo--------------- Worthing	0-16	Silty clay loam	CL, CH, MH, ML	A-7	0	100	100	95-100	85-100	40-60	15-30
	16-42	Silty clay, clay	CH, MH	A-7	0	100	100	95-100	85-100	50-70	22-35
	42-60	Silty clay, silty clay loam, clay loam.	CL, CH, ML, MH	A-7	0	100	95-100	90-100	70-100	40-65	15-30

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
							K	T		
	In	In/hr	In/in	pH	Mmhos/cm					Pct
Ac	0-10	0.6-2.0	0.19-0.22	5.6-7.8	<2	Moderate	0.28	5	6	4-8
Alcester	10-38	0.6-2.0	0.19-0.22	6.1-7.8	<2	Moderate	0.28			
	38-60	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43			
Ar	0-11	0.6-2.0	0.19-0.22	6.6-8.4	<2	Moderate	0.28	4	4L	2-4
Arlo	11-18	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28			
	18-35	0.6-2.0	0.13-0.17	7.4-8.4	<4	Low	0.28			
	35-60	6.0-20	0.03-0.06	7.4-8.4	<4	Low	0.10			
Ba	0-12	0.2-0.6	0.16-0.16	7.4-8.4	<2	Moderate	0.37	5	7	4-8
Baltic	12-32	0.06-0.2	0.11-0.18	7.4-8.4	2-4	High	0.37			
	32-60	0.06-0.6	0.08-0.17	7.4-8.4	2-4	High	0.37			
Bb	0-18	0.2-0.6	0.16-0.16	7.4-8.4	<2	Moderate	0.37	5	8	4-8
Baltic	18-49	0.06-0.2	0.11-0.18	7.4-8.4	2-4	High	0.37			
	49-60	0.06-0.6	0.08-0.17	7.4-8.4	2-4	High	0.37			
BeE*:										
Betts	0-4	0.6-2.0	0.16-0.18	6.6-8.4	<2	Moderate	0.28	5	4L	1-3
	4-26	0.6-2.0	0.17-0.20	7.4-8.4	<2	Moderate	0.37			
	26-60	0.2-0.6	0.17-0.20	7.4-8.4	2-8	Moderate	0.37			
Ethan	0-8	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate	0.28	5	4L	1-3
	8-21	0.6-2.0	0.16-0.20	7.4-8.4	<2	Moderate	0.37			
	21-60	0.2-2.0	0.16-0.20	7.4-9.0	2-8	Moderate	0.37			
BhE*:										
Betts	0-4	0.6-2.0	0.16-0.18	6.6-8.4	<2	Moderate	0.28	5	4L	1-3
	4-26	0.6-2.0	0.17-0.20	7.4-8.4	<2	Moderate	0.37			
	26-60	0.2-0.6	0.17-0.20	7.4-8.4	2-8	Moderate	0.37			
Talmo	0-7	0.6-2.0	0.11-0.15	6.6-7.8	<2	Low	0.20	2	3	1-2
	7-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low	0.10			
BkA	0-8	2.0-6.0	0.11-0.17	5.6-7.3	<2	Low	0.20	5	3	2-4
Blendon	8-36	0.6-6.0	0.11-0.18	6.1-7.3	<2	Low	0.20			
	36-60	2.0-20	0.08-0.15	6.6-8.4	<2	Low	0.20			
BmB*:										
Blendon	0-8	2.0-6.0	0.11-0.17	5.6-7.3	<2	Low	0.20	5	3	2-4
	8-36	0.6-6.0	0.11-0.18	6.1-7.3	<2	Low	0.20			
	36-60	2.0-20	0.08-0.15	6.6-8.4	<2	Low	0.20			
Henkin	0-7	2.0-6.0	0.11-0.17	5.6-7.3	<2	Low	0.20	5	3	1-3
	7-48	2.0-6.0	0.09-0.18	6.1-8.4	<2	Low	0.20			
	48-60	2.0-20	0.08-0.16	6.1-8.4	<2	Low	0.20			
Ca	0-18	0.06-0.6	0.13-0.19	6.1-7.3	<2	High	0.28	5	7	4-6
Chancellor	18-44	0.06-0.2	0.11-0.19	6.1-7.8	<2	High	0.28			
	44-60	0.06-0.6	0.14-0.20	7.4-8.4	2-4	High	0.28			
Cc	0-9	0.6-2.0	0.20-0.22	6.6-7.8	<2	Low	0.28	5	4L	2-5
Chaska	9-40	0.6-2.0	0.17-0.19	7.4-7.8	<2	Low	0.28			
	40-60	0.6-6.0	0.07-0.16	7.4-8.4	<2	Low	0.28			
Cd	0-12	0.06-0.2	0.16-0.19	6.1-7.8	<2	High	0.28	5	4	4-6
Clamo	12-60	0.06-0.2	0.13-0.18	6.6-8.4	2-8	High	0.28			
Ce	0-11	0.06-0.2	0.13-0.19	6.1-7.8	<2	High	0.28	5	4	4-6
Clamo	11-36	0.06-0.2	0.13-0.19	6.6-8.4	<2	High	0.28			
	36-51	0.06-0.2	0.11-0.18	7.4-8.4	2-8	High	0.28			
	51-60	6.0-20	0.03-0.06	7.4-8.4	2-8	Low	0.10			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
							K	T		
	In	In/hr	In/in	pH	Mmhos/cm					Pct
ChA*:										
Clarno	0-8	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low	0.28	5	6	2-4
	8-29	0.6-2.0	0.16-0.20	6.6-8.4	<2	Moderate	0.37			
	29-60	0.2-0.6	0.16-0.20	7.4-9.0	2-8	Moderate	0.37			
Bonilla	0-12	0.6-2.0	0.18-0.20	5.6-7.3	<2	Low	0.24	5	6	4-6
	12-32	0.6-2.0	0.18-0.22	6.1-7.8	<2	Moderate	0.24			
	32-60	0.2-2.0	0.16-0.20	7.4-8.4	<8	Moderate	0.37			
ChB*:										
Clarno	0-8	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low	0.28	5	6	2-4
	8-27	0.6-2.0	0.16-0.20	6.6-8.4	<2	Moderate	0.37			
	27-60	0.2-0.6	0.16-0.20	7.4-9.0	2-8	Moderate	0.37			
Bonilla	0-13	0.6-2.0	0.18-0.20	5.6-7.3	<2	Low	0.24	5	6	4-6
	13-35	0.6-2.0	0.18-0.22	6.1-7.8	<2	Moderate	0.24			
	35-60	0.2-2.0	0.16-0.20	7.4-8.4	<8	Moderate	0.37			
CkA*:										
Clarno	0-9	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low	0.28	5	6	2-4
	9-30	0.6-2.0	0.16-0.20	6.6-8.4	<2	Moderate	0.37			
	30-60	0.2-0.6	0.16-0.20	7.4-9.0	2-8	Moderate	0.37			
Crossplain	0-9	0.2-0.6	0.19-0.22	6.1-7.3	<2	Moderate	0.24	5	6	3-6
	9-38	0.06-0.6	0.11-0.17	6.1-7.3	<2	High	0.32			
	38-60	0.06-0.6	0.16-0.20	6.6-8.4	2-8	Moderate	0.32			
Davison	0-10	0.6-2.0	0.18-0.20	6.6-8.4	<2	Moderate	0.28	5	4L	2-4
	10-25	0.6-2.0	0.13-0.17	7.4-9.0	<2	Moderate	0.37			
	25-60	0.2-2.0	0.16-0.20	7.4-8.4	2-8	Moderate	0.37			
CmB*:										
Clarno	0-8	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low	0.28	5	6	2-4
	8-29	0.6-2.0	0.16-0.20	6.6-8.4	<2	Moderate	0.37			
	29-60	0.2-0.6	0.16-0.20	7.4-9.0	2-8	Moderate	0.37			
Davison	0-10	0.6-2.0	0.18-0.20	6.6-8.4	<2	Moderate	0.28	5	4L	2-4
	10-25	0.6-2.0	0.13-0.17	7.4-9.0	<2	Moderate	0.37			
	25-60	0.2-2.0	0.16-0.20	7.4-8.4	2-8	Moderate	0.37			
CoB*:										
Clarno	0-8	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low	0.28	5	6	2-4
	8-27	0.6-2.0	0.16-0.20	6.6-8.4	<2	Moderate	0.37			
	27-60	0.2-0.6	0.16-0.20	7.4-9.0	2-8	Moderate	0.37			
Ethan	0-8	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate	0.28	5	4L	1-3
	8-21	0.6-2.0	0.16-0.20	7.4-8.4	<2	Moderate	0.37			
	21-60	0.2-2.0	0.16-0.20	7.4-9.0	2-8	Moderate	0.37			
CoC*:										
Clarno	0-8	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low	0.28	5	6	2-4
	8-24	0.6-2.0	0.16-0.20	6.6-8.4	<2	Moderate	0.37			
	24-60	0.2-0.6	0.16-0.20	7.4-9.0	2-8	Moderate	0.37			
Ethan	0-8	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate	0.28	5	4L	1-3
	8-21	0.6-2.0	0.16-0.20	7.4-8.4	<2	Moderate	0.37			
	21-60	0.2-2.0	0.16-0.20	7.4-9.0	2-8	Moderate	0.37			
Cr	0-16	0.2-0.6	0.19-0.22	6.1-7.3	<2	Moderate	0.24	5	6	3-6
Crossplain	16-43	0.06-0.6	0.11-0.17	6.1-7.3	<2	High	0.32			
	43-60	0.06-0.6	0.16-0.20	6.6-8.4	2-8	Moderate	0.32			
DaA	0-14	0.6-2.0	0.18-0.22	6.1-7.3	<2	Moderate	0.24	5	6	4-6
Davis	14-48	0.6-2.0	0.18-0.22	6.1-7.8	<2	Moderate	0.24			
	48-60	0.6-2.0	0.18-0.20	6.6-8.4	<2	Moderate	0.24			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
							K	T		
	In	In/hr	In/in	pH	Mmhos/cm					Pct
DaB----------	0-14	0.6-2.0	0.18-0.22	6.1-7.3	<2	Moderate----	0.24	5	6	4-6
Davis	14-38	0.6-2.0	0.18-0.22	6.1-7.8	<2	Moderate----	0.24			
	38-60	0.6-2.0	0.18-0.20	6.6-8.4	<2	Moderate----	0.24			
DbA----------	0-10	0.6-2.0	0.18-0.22	6.1-7.3	<2	Moderate----	0.24	5	6	4-6
Davis	10-30	0.6-2.0	0.18-0.22	6.1-7.8	<2	Moderate----	0.24			
	30-36	2.0-6.0	0.09-0.13	6.6-8.4	<2	Low---------	0.24			
	36-60	6.0-20.0	0.03-0.06	7.4-8.4	<2	Low---------	0.10			
DeA*, DeB*:										
Delmont---------	0-8	0.6-2.0	0.18-0.20	6.6-7.8	<2	Low---------	0.28	3	6	2-4
	8-18	0.6-6.0	0.12-0.18	6.6-7.8	<2	Low---------	0.28			
	18-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low---------	0.10			
Enet----------	0-8	0.6-2.0	0.18-0.20	5.6-7.3	<2	Low---------	0.28	4	6	2-4
	8-20	0.6-2.0	0.18-0.22	6.6-7.8	<2	Low---------	0.28			
	20-24	0.6-6.0	0.11-0.20	6.6-8.4	<2	Low---------	0.28			
	24-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low---------	0.10			
DgB*:										
Dempster--------	0-8	0.6-2.0	0.19-0.22	5.6-7.3	<2	Moderate----	0.32	4	7	3-6
	8-26	0.6-2.0	0.17-0.20	6.1-7.3	<2	Moderate----	0.32			
	26-34	0.6-2.0	0.13-0.17	7.4-8.4	<2	Moderate----	0.32			
	34-60	2.0-20	0.03-0.06	7.4-8.4	<2	Low---------	0.10			
Graceville------	0-18	0.6-2.0	0.19-0.22	5.6-7.3	<2	Moderate----	0.32	5	7	4-8
	18-52	0.6-2.0	0.17-0.22	5.6-7.3	<2	Moderate----	0.32			
	52-60	6.0-20	0.03-0.06	6.1-7.8	<2	Low---------	0.10			
Do----------	0-9	0.6-2.0	0.18-0.20	5.6-7.3	<2	Moderate----	0.24	4	7	4-6
Dimo	9-29	0.6-2.0	0.16-0.20	6.1-7.3	<2	Moderate----	0.24			
	29-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low---------	0.10			
EeA*, EeB*:										
Egan----------	0-8	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate----	0.32	5	7	3-6
	8-30	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate----	0.43			
	30-60	0.06-0.6	0.17-0.20	7.4-9.0	2-8	Moderate----	0.43			
Ethan----------	0-8	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate----	0.28	5	4L	1-3
	8-21	0.6-2.0	0.16-0.20	7.4-8.4	<2	Moderate----	0.37			
	21-60	0.2-2.0	0.16-0.20	7.4-9.0	2-8	Moderate----	0.37			
EfA*:										
Egan----------	0-8	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate----	0.32	5	7	3-6
	8-30	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate----	0.43			
	30-60	0.06-0.6	0.17-0.20	7.4-9.0	2-8	Moderate----	0.43			
Trent----------	0-12	0.6-2.0	0.19-0.22	5.6-7.3	<2	Moderate----	0.28	5	7	4-6
	12-38	0.6-2.0	0.17-0.20	6.1-7.3	<2	Moderate----	0.43			
	38-60	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate----	0.43			
EgB*:										
Egan----------	0-8	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate----	0.32	5	7	3-6
	8-26	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate----	0.43			
	26-60	0.06-0.6	0.17-0.20	7.4-9.0	2-8	Moderate----	0.43			
Wentworth-------	0-8	0.6-2.0	0.19-0.22	5.6-7.3	<2	Moderate----	0.32	5	7	3-6
	8-26	0.6-2.0	0.18-0.21	6.1-7.3	<2	Moderate----	0.43			
	26-36	0.6-2.0	0.17-0.20	7.4-8.4	<2	Moderate----	0.43			
	36-60	0.2-0.6	0.16-0.20	7.4-8.4	2-4	Moderate----	0.43			
EnA----------	0-8	0.6-2.0	0.18-0.20	5.6-7.3	<2	Low---------	0.28	4	6	2-4
Enet	8-25	0.6-2.0	0.18-0.22	6.6-7.8	<2	Low---------	0.28			
	25-30	0.6-6.0	0.11-0.20	6.6-8.4	<2	Low---------	0.28			
	30-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low---------	0.10			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
							K	T		
	In	In/hr	In/in	pH	Mmhos/cm					Pct
EsD*:										
Ethan	0-8	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate	0.28	5	4L	1-3
	8-21	0.6-2.0	0.16-0.20	7.4-8.4	<2	Moderate	0.37			
	21-60	0.2-2.0	0.16-0.20	7.4-9.0	2-8	Moderate	0.37			
Betts	0-9	0.6-2.0	0.16-0.18	6.6-8.4	<2	Moderate	0.28	5	4L	1-3
	9-26	0.6-2.0	0.17-0.20	7.4-8.4	<2	Moderate	0.37			
	26-60	0.2-0.6	0.17-0.20	7.4-8.4	2-8	Moderate	0.37			
EtB*:										
Ethan	0-8	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate	0.28	5	4L	1-3
	8-21	0.6-2.0	0.16-0.20	7.4-8.4	<2	Moderate	0.37			
	21-60	0.2-2.0	0.16-0.20	7.4-9.0	2-8	Moderate	0.37			
Egan	0-9	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	0.32	5	7	3-6
	9-22	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43			
	22-60	0.06-0.6	0.17-0.20	7.4-9.0	2-8	Moderate	0.43			
EtC*:										
Ethan	0-8	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate	0.28	5	4L	1-3
	8-21	0.6-2.0	0.16-0.20	7.4-8.4	<2	Moderate	0.37			
	21-60	0.2-2.0	0.16-0.20	7.4-9.0	2-8	Moderate	0.37			
Egan	0-8	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	0.32	5	7	3-6
	8-23	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43			
	23-60	0.06-0.6	0.17-0.20	7.4-9.0	2-8	Moderate	0.43			
HuA	0-8	0.06-0.2	0.13-0.19	5.6-7.3	<2	High	0.28	5	4	3-6
Huntimer	8-20	0.06-0.2	0.11-0.19	6.1-7.3	<2	High	0.28			
	20-44	0.06-0.2	0.11-0.20	7.4-8.4	<2	High	0.28			
	44-60	0.06-0.6	0.11-0.20	7.4-8.4	<4	Moderate	0.28			
La	0-27	0.2-0.6	0.21-0.23	7.4-8.4	<2	High	0.32	5	7	3-6
Lamo	27-60	0.2-0.6	0.18-0.22	7.4-8.4	<2	High	0.32			
Or*:										
Orthents.										
Aquents.										
Ro	0-20	0.6-2.0	0.22-0.24	6.6-8.4	<2	Low	0.32	5	6	4-8
Roxbury	20-36	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
	36-60	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
Rv	0-8	0.6-2.0	0.19-0.22	6.6-7.8	<2	Low	0.32	5	6	4-8
Roxbury Variant	8-24	0.6-2.0	0.19-0.22	6.6-8.4	<2	Low	0.32			
	24-45	0.06-0.2	0.10-0.17	7.4-8.4	2-4	High	0.32			
	45-60	0.06-0.2	0.10-0.15	7.4-8.4	2-4	High	0.32			
Sa	0-28	0.2-0.6	0.19-0.24	6.6-8.4	4-16	Moderate	0.28	5	7	3-6
Salmo	28-36	0.2-2.0	0.17-0.20	6.6-8.4	4-16	Moderate	0.28			
	36-60	0.06-0.6	0.11-0.20	6.6-8.4	4-16	Moderate	0.28			
Te	0-18	0.6-2.0	0.19-0.22	5.6-7.3	<2	Moderate	0.24	3	6	4-8
Tetonka	18-34	<0.2	0.13-0.19	6.1-7.8	<2	High	0.32			
	34-60	0.06-0.6	0.11-0.17	6.6-8.4	2-8	High	0.32			
WaA*:										
Wakonda	0-8	0.6-2.0	0.19-0.22	6.6-8.4	2-4	Moderate	0.28	5	4L	3-6
	8-32	0.6-2.0	0.14-0.17	7.4-8.4	4-8	Moderate	0.43			
	32-60	0.2-0.6	0.16-0.20	7.4-8.4	<8	Moderate	0.43			
Wentworth	0-9	0.6-2.0	0.19-0.22	5.6-7.3	<2	Moderate	0.32	5	7	3-6
	9-22	0.6-2.0	0.18-0.21	6.1-7.3	<2	Moderate	0.43			
	22-42	0.6-2.0	0.17-0.20	7.4-8.4	<2	Moderate	0.43			
	42-60	0.2-0.6	0.16-0.20	7.4-8.4	2-4	Moderate	0.43			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
							K	T		
	In	In/hr	In/in	pH	Mmhos/cm					Pct
WaA*:										
Chancellor------	0-11	0.06-0.6	0.13-0.19	6.1-7.3	<2	High--------	0.28	5	7	4-6
	11-36	0.06-0.2	0.11-0.19	6.1-7.8	<2	High--------	0.28			
	36-60	0.06-0.6	0.14-0.20	7.4-8.4	2-4	High--------	0.28			
WcA*:										
Wentworth-------	0-9	0.6-2.0	0.19-0.22	5.6-7.3	<2	Moderate-----	0.32	5	7	3-6
	9-22	0.6-2.0	0.18-0.21	6.1-7.3	<2	Moderate-----	0.43			
	22-42	0.6-2.0	0.17-0.20	7.4-8.4	<2	Moderate-----	0.43			
	42-60	0.2-0.6	0.16-0.20	7.4-8.4	2-4	Moderate-----	0.43			
Chancellor------	0-11	0.06-0.6	0.13-0.19	6.1-7.3	<2	High--------	0.28	5	7	4-6
	11-36	0.06-0.2	0.11-0.19	6.1-7.8	<2	High--------	0.28			
	36-60	0.06-0.6	0.14-0.20	7.4-8.4	2-4	High--------	0.28			
Wakonda---------	0-8	0.6-2.0	0.19-0.22	6.6-8.4	2-4	Moderate-----	0.28	5	4L	3-6
	8-32	0.6-2.0	0.14-0.17	7.4-8.4	4-8	Moderate-----	0.43			
	32-60	0.2-0.6	0.16-0.20	7.4-8.4	<8	Moderate-----	0.43			
Wo---------------	0-16	0.2-0.6	0.19-0.22	5.6-7.3	<2	Moderate-----	0.37	5	7	3-5
Worthing	16-42	0.06-0.2	0.13-0.18	6.1-7.3	<2	High--------	0.37			
	42-60	0.2-0.6	0.11-0.17	7.4-8.4	2-8	High--------	0.37			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
Ac---------- Alcester	B	Occasional	Brief-----	Mar-Oct	3.0-6.0	Apparent	Oct-Jun	High-----	Moderate	Low.
Ar---------- Arlo	B	Frequent----	Brief-----	Mar-Aug	0-2.0	Apparent	Oct-Jun	High-----	High-----	Moderate.
Ba---------- Baltic	D	None--------	---	---	+1-2.0	Apparent	Jan-Dec	High-----	High-----	Moderate.
Bb---------- Baltic	D	None--------	---	---	+2-0.0	Apparent	Jan-Dec	High-----	High-----	Moderate.
BeE*:										
Betts----------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Moderate.
Ethan----------	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
BhE*:										
Betts----------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Moderate.
Talmo----------	A	None--------	---	---	>6.0	---	---	Low------	Moderate	Low.
BkA---------- Blendon	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Low.
BmB*:										
Blendon----------	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Low.
Henkin----------	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Low.
Ca---------- Chancellor	C	Frequent----	Brief-----	Sep-Jun	0-3.0	Perched	Sep-Jun	High-----	High-----	Moderate.
Cc---------- Chaska	B/D	Frequent----	Brief-----	Apr-Jun	1.0-3.0	Apparent	Nov-Jun	High-----	High-----	Low.
Cd---------- Clamo	C/D	Occasional	Long------	Mar-Oct	0-3.0	Apparent	Oct-Jun	High-----	High-----	High.
Ce---------- Clamo	C/D	Occasional	Long------	Mar-Sep	0-3.0	Apparent	Oct-Jul	High-----	High-----	High.
ChA*, ChB*:										
Clarno----------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Moderate.
Bonilla----------	B	Frequent----	Very brief	Apr-Oct	3.0-6.0	Perched	Oct-Jun	Moderate	High-----	Moderate.
CkA*:										
Clarno----------	B	None--------	---	---	3.0-6.0	Perched	Oct-Jul	Moderate	High-----	Moderate.
Crossplain-------	C/D	Frequent----	Brief-----	Sep-Jun	0-3.0	Perched	Sep-Jun	High-----	High-----	Moderate.
Davison----------	B	None--------	---	---	1.5-4.0	Perched	Mar-Jun	High-----	High-----	Moderate.
CmB*:										
Clarno----------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Moderate.
Davison----------	B	None--------	---	---	1.5-4.0	Perched	Mar-Jun	High-----	High-----	Moderate.
CoB*, CoC*:										
Clarno----------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Moderate.
Ethan----------	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Moderate.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
Cr Crossplain	C/D	Frequent	Brief	Sep-Jun	0-3.0	Perched	Sep-Jun	High	High	Moderate.
DaA Davis	B	Occasional	Brief	Mar-Oct	>6.0	---	---	Moderate	Moderate	Low.
DaB Davis	B	None	---	---	>6.0	---	---	Moderate	Moderate	Low.
DbA Davis	B	Rare	---	---	>6.0	---	---	Moderate	Moderate	Low.
DeA*, DeB*: Delmont	B	None	---	---	>6.0	---	---	Low	Moderate	Low.
Enet	B	None	---	---	>6.0	---	---	Low	Moderate	Low.
DgB*: Dempster	B	None	---	---	>6.0	---	---	High	Moderate	Low.
Graceville	B	None	---	---	>6.0	---	---	High	Moderate	Low.
Do Dimo	B	Frequent	Very brief	Mar-Oct	2.0-6.0	Apparent	Oct-Jun	High	High	Low.
EeA*, EeB*: Egan	B	None	---	---	>6.0	---	---	High	High	Moderate.
Ethan	B	None	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
EfA*: Egan	B	None	---	---	>6.0	---	---	High	High	Moderate.
Trent	B	Frequent	Very brief	Oct-Jun	3.5-6.0	Perched	Oct-Jun	High	Moderate	Low.
EgB*: Egan	B	None	---	---	>6.0	---	---	High	High	Moderate.
Wentworth	B	None	---	---	>6.0	---	---	High	High	Low.
EnA Enet	B	None	---	---	>6.0	---	---	Low	Moderate	Low.
EsD*: Ethan	B	None	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
Betts	B	None	---	---	>6.0	---	---	Moderate	High	Moderate.
EtB*, EtC*: Ethan	B	None	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
Egan	B	None	---	---	>6.0	---	---	High	High	Moderate.
HuA Huntimer	C	None	---	---	>6.0	---	---	Moderate	High	Moderate.
La Lamo	C	Occasional	Brief	Mar-Aug	1.5-3.0	Apparent	Nov-May	High	High	Low.
Or*: Orthents.										
Aquents.										
Ro Roxbury	B	Occasional	Very brief	Apr-Sep	>6.0	---	---	Moderate	Low	Low.
Rv Roxbury Variant	B	Occasional	Brief	Mar-Oct	4.0-6.0	Apparent	Oct-Jun	Moderate	High	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
Sa---------- Salmo	C/D	Frequent----	Brief-----	Mar-Oct	0-2.5	Apparent	Sep-Jun	High-----	High-----	High.
Te---------- Tetonka	C/D	None--------	---	---	+1-1.0	Perched	Jan-Dec	High-----	High-----	Moderate.
WaA*:										
Wakonda----------	C	None--------	---	---	1.5-4.0	Perched	Sep-Jun	High-----	High-----	Moderate.
Wentworth--------	B	None--------	---	---	3.0-6.0	Perched	Oct-Jul	High-----	High-----	Moderate.
Chancellor-------	C	Frequent----	Brief-----	Sep-Jun	0-3.0	Perched	Sep-Jun	High-----	High-----	Moderate.
WcA*:										
Wentworth--------	B	None--------	---	---	3.0-6.0	Perched	Oct-Jul	High-----	High-----	Moderate.
Chancellor-------	C	Frequent----	Brief-----	Sep-Jun	0-3.0	Perched	Sep-Jun	High-----	High-----	Moderate.
Wakonda----------	C	None--------	---	---	1.5-4.0	Perched	Sep-Jun	High-----	High-----	Moderate.
Wo---------- Worthing	D	None--------	---	---	+1-1.0	Perched	Jan-Dec	High-----	High-----	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX TEST DATA

[Dashes indicate data were not available]

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution								Liquid limit	Plasticity index	Moisture density	
			Percentage passing sieve--					Percentage smaller than--					Maximum density	Optimum moisture
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm				
											Pct		Lb/ft^3	Pct
Arlo loam: (S78SD-125-083)														
Ap-------0 to 11	A-7-6(12)	ML	100	100	100	87	71	--	32	--	47	18	97	23
C1ca----18 to 31	A-5(05)	SC	100	99	93	67	46	--	23	--	33	20	117	14
IIC-----35 to 60	A-2-4(00)	SM-SC	100	95	85	37	12	--	6	--	27	7	121	12
Baltic silty clay loam: (S76SD-125-108)														
A1------0 to 17	A-7-5(20)	CH	100	100	100	99	95	--	44	--	63	32	104	20
B2-----17 to 44	A-7-6(18)	CH	100	100	100	99	96	--	46	--	52	28	96	24
Cg-----44 to 60	A-7-6(16)	CL	100	100	100	98	96	--	42	--	48	26	101	20
Blendon fine sandy loam: (S78SD-125-141)														
B2------8 to 24	A-2-4(00)	SM	100	100	100	85	24	--	10	--	21	2	121	12
C------33 to 60	A-2-4(00)	SM	100	100	99	77	20	--	8	--	20	1	121	12
Bonilla loam: (S76SD-125-029)														
A--------0 to 11	A-6(10)	CL	100	100	100	97	82	--	36	--	38	14	99	22
B-------11 to 29	A-7-6(06)	CL	100	99	98	95	82	--	41	--	46	21	99	22
C-------29 to 60	A-6(10)	CL	100	99	98	92	69	--	33	--	38	18	107	13
Chancellor silty clay loam: (S78SD-125-042)														
B21----11 to 23	A-7-6(16)	CH	100	100	100	99	96	--	42	--	50	24	96	24
B3-----28 to 36	A-7-6(19)	CH	100	100	100	100	99	--	40	--	52	29	104	20
C1ca---36 to 46	A-7-6(15)	CL	100	100	100	100	98	--	36	--	46	24	106	19
Clamo silty clay: (S78SD-125-024)														
Ap-------0 to 7	A-7-6(18)	CH	100	100	100	99	94	--	50	--	57	28	89	28
B21g----12 to 23	A-7-6(20)	CH	100	100	100	99	93	--	54	--	64	35	88	30
C2------46 to 60	A-7-6(13)	CL	100	100	99	98	81	--	31	--	42	22	105	19
Clamo clay gravelly substratum: (S78SD-125-071)														
B2g----11 to 29	A-7-6(19)	CH	100	100	99	90	74	--	43	--	59	34	96	24
C1-----36 to 46	A-7-6(06)	SC	100	100	98	74	42	--	23	--	44	26	117	14

TABLE 17.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution								Liquid limit	Plasticity index	Moisture density	
			Percentage passing sieve--					Percentage smaller than--						
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			Maximum density	Optimum moisture
											Pct		Lb/ft^3	Pct
Clarno loam: (S76SD-125-010)														
Ap-------0 to 8	A-6(10)	CL	100	100	99	95	78	--	34	--	39	16	96	24
B2-------8 to 18	A-7-6(12)	CL	100	100	99	96	76	--	38	--	42	18	98	22
C-------23 to 60	A-6(11)	CL	100	97	96	90	72	--	36	--	40	20	104	20
Davis loam: (S78SD-125-136)														
Ap-------0 to 9	A-4(06)	ML	100	100	99	94	64	--	22	--	32	9	104	20
B21-----14 to 29	A-7-6(10)	ML	100	100	100	98	79	--	28	--	42	14	93	25
Cca-----48 to 60	A-7-6(11)	CL	100	100	100	99	85	--	34	--	42	13	99	22
Davison loam: (S76SD-125-011)														
Ap-------0 to 10	A-6(08)	CL	100	99	98	90	64	--	30	--	38	16	102	20
AC------10 to 25	A-6(10)	CL	100	99	98	93	71	--	42	--	37	17	107	18
C-------25 to 60	A-6(06)	CL	100	99	96	87	55	--	23	--	31	14	113	15
Delmont loam: (S79SD-125-009)														
B21------8 to 12	A-4(01)	SM	100	100	98	76	42	--	13	--	33	9	108	18
IIC1ca--18 to 23	A-1-a(00)	SW-SM	100	61	46	24	7	--	3	--	25	3	133	9
IIC2----23 to 60	A-1-b(00)	SW	100	90	82	40	4	--	3	--	19	1	117	12
Dimo clay loam: (S78SD-125-028)														
B21------9 to 20	A-7-6(17)	CH	100	100	100	88	73	--	40	--	52	27	96	24
IIC-----29 to 60	A-1-b(00)	SW-SM	100	100	88	43	7	--	3	--	18	1	117	12
Egan silty clay loam: (S78SD-125-088)														
B2------8 to 16	A-7-6(14)	CL	100	100	100	100	99	--	36	--	46	22	100	22
IIC----26 to 60	A-7-6(17)	CH	100	98	96	87	71	--	44	--	51	29	104	20
Enet loam: (S78SD-125-008)														
B2-------8 to 20	A-6(02)	SM	100	100	98	76	45	--	9	--	33	11	111	16
IIC-----29 to 60	A-1-b(00)	SW-SM	100	94	88	32	6	--	3	--	21	0	114	14
Ethan loam: (S78SD-125-109)														
AC-------8 to 22	A-6(10)	CL	100	96	95	89	68	--	34	--	37	18	108	18
C2------34 to 60	A-6(09)	CL	100	96	94	87	64	--	28	--	35	17	110	17

TABLE 17.--ENGINEERING INDEX TEST DATA--Continued

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution								Liquid limit	Plasticity index	Moisture density	
			Percentage passing sieve--					Percentage smaller than--					Maximum density	Optimum moisture
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm				
											Pct		Lb/ft^3	Pct
Henkin fine sandy loam: (S78SD-125-041)														
B21-----7 to 12	A-6-4(00)	SM	100	100	99	83	25	--	10	--	23	3	117	14
B3-----19 to 30	A-2-4(00)	SM	100	100	99	84	19	--	8	--	19	0	118	13
C2-----48 to 60	A-2-4(00)	SM	100	100	99	83	21	--	6	--	19	0	117	14
Roxbury silt loam: (S78SD-125-128)														
Ap-------0 to 9	A-7-6(11)	ML	100	100	100	100	91	--	30	--	44	16	92	26
A12------9 to 20	A-7-6(11)	ML	100	100	100	100	92	--	32	--	46	16	91	26
B2------20 to 36	A-7-6(13)	ML	100	100	100	100	94	--	36	--	45	19	95	24
C2------52 to 60	A-6(10)	CL	100	100	100	100	81	--	28	--	36	15	104	20
Roxbury Variant silt loam: (S78SD-125-045)														
A13----12 to 24	A-7-6(11)	ML	100	100	100	100	91	--	34	--	44	16	96	24
IIB2g--24 to 37	A-7-6(16)	CH	100	100	100	96	68	--	41	--	51	30	100	22
Trent silty clay loam: (S78SD-125-100)														
Ap------0 to 8	A-7-6(11)	ML	100	100	99	95	--	--	36	--	45	16	91	26
B21----12 to 26	A-7-6(13)	CL	100	100	100	97	--	--	38	--	47	21	97	23
C------42 to 60	A-7-6(14)	CL	100	100	99	97	--	--	32	--	44	22	105	19
Wakonda silty clay loam: (S78SD-125-030)														
C1-----11 to 28	A-6(12)	CL	100	100	99	92	--	--	42	--	40	19	106	19
C2-----28 to 39	A-7-6(12)	CL	100	100	99	94	--	--	42	--	41	21	107	18
C5-----54 to 60	A-7-6(13)	CL	100	100	96	88	--	--	42	--	44	20	100	22
Wentworth silty clay loam: (S76SD-125-013)														
B2------9 to 24	A-7-6(13)	CL	100	100	100	100	96	--	36	--	46	21	94	24
B3-----24 to 44	A-7-6(12)	CL	100	100	99	98	95	--	34	--	40	20	104	19
IIC----44 to 60	A-7-6(14)	CL	100	99	98	88	70	--	39	--	42	24	107	18
Worthing silty clay loam: (S76SD-125-009)														
A1------0 to 16	A-7-5(18)	MH	100	100	100	99	96	--	44	--	56	26	84	31
B2-----16 to 42	A-7-6(19)	CH	100	100	100	99	96	--	48	--	56	33	98	22
C------42 to 60	A-7-6(16)	CH	100	100	100	98	96	--	40	--	48	26	97	22

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Alcester	Fine-silty, mixed, mesic Cumulic Haplustolls
Aquents	Mixed, mesic Typic Psammaquents
Arlo	Fine-loamy over sandy or sandy-skeletal, mesic Typic Calciaquolls
Baltic	Fine, montmorillonitic (calcareous), mesic Cumulic Haplaquolls
Betts	Fine-loamy, mixed (calcareous), mesic Typic Ustorthents
Blendon	Coarse-loamy, mixed, mesic Pachic Haplustolls
Bonilla	Fine-loamy, mixed, mesic Pachic Haplustolls
Chancellor	Fine, montmorillonitic, mesic Typic Argiaquolls
Chaska	Fine-loamy, mixed (calcareous), mesic Mollic Fluvaquents
Clamo	Fine, montmorillonitic, mesic Cumulic Haplaquolls
Clarno	Fine-loamy, mixed, mesic Typic Haplustolls
Crossplain	Fine, montmorillonitic, mesic Typic Argiaquolls
Davis	Fine-loamy, mixed, mesic Pachic Haplustolls
Davison	Fine-loamy, mesic Aquic Calciustolls
Delmont	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplustolls
Dempster	Fine-silty over sandy or sandy-skeletal, mixed, mesic Udic Haplustolls
Dimo	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Pachic Haplustolls
Egan	Fine-silty, mixed, mesic Udic Haplustolls
Enet	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Pachic Haplustolls
Ethan	Fine-loamy, mixed, mesic Typic Calciustolls
Graceville	Fine-silty, mixed, mesic Pachic Haplustolls
Henkin	Coarse-loamy, mixed, mesic Udic Haplustolls
Huntimer	Fine, montmorillonitic, mesic Udic Haplustolls
Lamo	Fine-silty, mixed (calcareous), mesic Cumulic Haplaquolls
Orthents	Loamy-skeletal, mixed, mesic Typic Ustorthents
Roxbury	Fine-silty, mixed, mesic Cumulic Haplustolls
Roxbury Variant	Fine silty over clayey, mixed, mesic Cumulic Haplustolls
Salmo	Fine-silty, mixed (calcareous), mesic Cumulic Haplaquolls
Talmo	Sandy-skeletal, mixed, mesic Udorthentic Haplustolls
Tetonka	Fine, montmorillonitic, mesic Argiaquic Argialbolls
Trent	Fine-silty, mixed, mesic Pachic Haplustolls
Wakonda	Fine-silty, mesic Aquic Calciustolls
Wentworth	Fine-silty, mixed, mesic Udic Haplustolls
Worthing	Fine, montmorillonitic, mesic Typic Argiaquolls

* U.S. GOVERNMENT PRINTING OFFICE: 1982 - 376 - 522/2028

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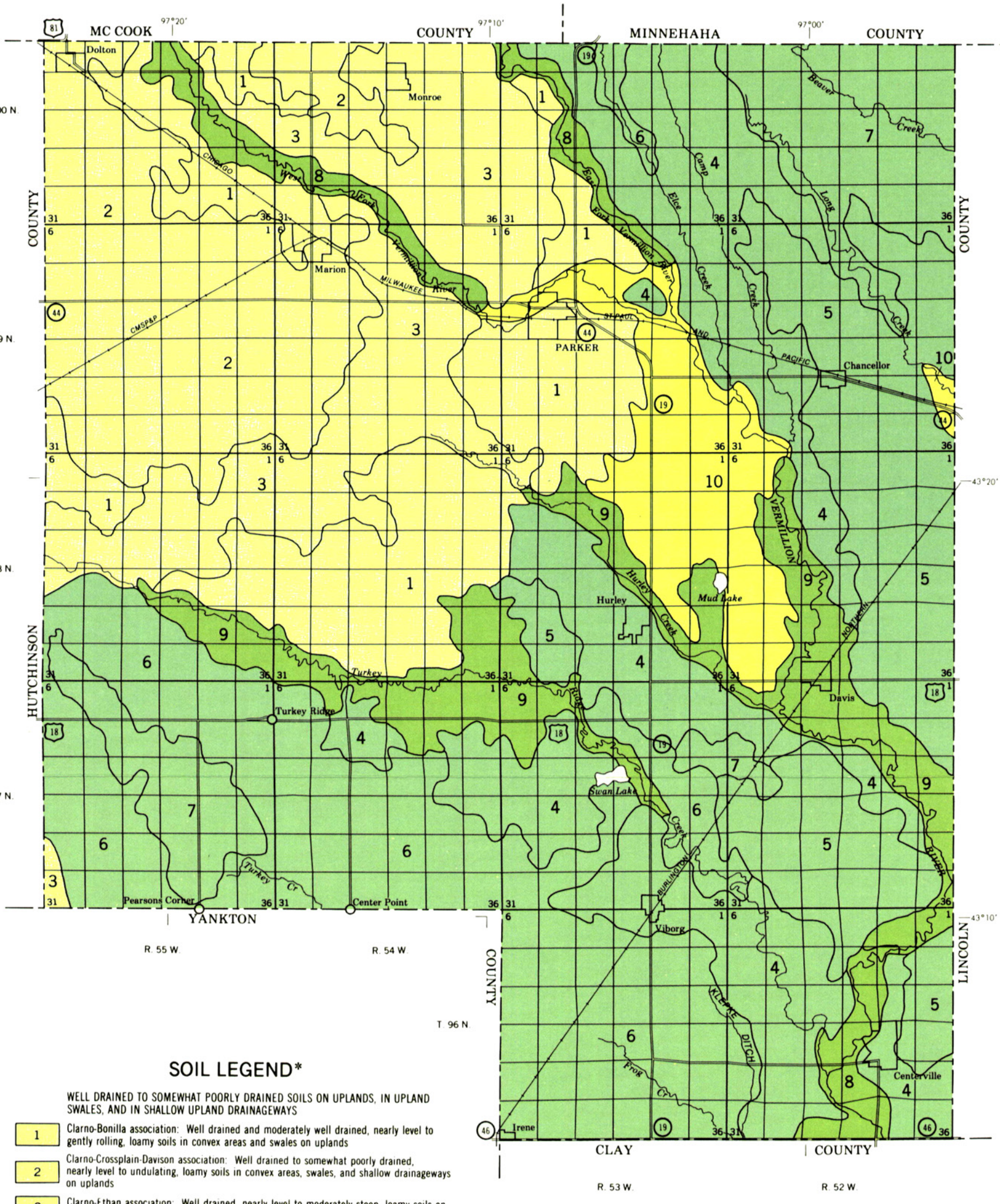


SOIL LEGEND*

WELL DRAINED TO SOMEWHAT POORLY DRAINED SOILS ON UPLANDS, IN UPLAND SWALES, AND IN SHALLOW UPLAND DRAINAGEWAYS

1 — Clarno-Bonilla association: Well drained and moderately well drained, nearly level to gently rolling, loamy soils in convex areas and swales on uplands

2 — Clarno-Crossplain-Davison association: Well drained to somewhat poorly drained, nearly level to undulating, loamy soils in convex areas, swales, and shallow drainageways on uplands

3 — Clarno-Ethan association: Well drained, nearly level to moderately steep, loamy soils on uplands

WELL DRAINED, MODERATELY WELL DRAINED, SOMEWHAT POORLY DRAINED, AND VERY POORLY DRAINED SOILS ON UPLANDS AND IN SWALES, SHALLOW DRAINAGEWAYS, AND DEPRESSIONS IN THE UPLANDS

4 — Egan-Trent association: Well drained and moderately well drained, nearly level to undulating, silty soils on uplands and in upland swales

5 — Wentworth-Chancellor-Wakonda association: Well drained to somewhat poorly drained, nearly level to undulating, silty soils in convex areas, swales, and shallow drainageways on uplands

6 — Egan-Ethan association: Well drained, nearly level to moderately steep, silty and loamy soils on uplands

7 — Egan-Worthing association: Well drained and very poorly drained, level to gently rolling, silty soils on uplands and in upland depressions

WELL DRAINED, SOMEWHAT POORLY DRAINED, AND POORLY DRAINED SOILS ON FLOOD PLAINS

8 — Roxbury-Davis-Chaska association: Well drained and somewhat poorly drained, nearly level and gently sloping, silty and loamy soils on flood plains

9 — Clamo-Lamo association: Poorly drained and somewhat poorly drained, level and nearly level, clayey and silty soils on flood plains

SOMEWHAT EXCESSIVELY DRAINED AND WELL DRAINED SOILS ON TERRACES

10 — Delmont-Enet association: Somewhat excessively drained and well drained, nearly level to undulating, loamy soils on terraces

*The texture terms in the descriptive headings refer to the surface layer of the major soils in each association.

Compiled 1981

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

TURNER COUNTY, SOUTH DAKOTA

Scale 1:190,080

1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS
TURNER COUNTY, SOUTH DAKOTA

Scale 1:190,080

1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

Original text from each individual map sheet read:

This map is compiled on 1976 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

Map symbols consist of a combination of letters. The first capital letter is the initial one of the map unit name. The lowercase letter that follows separates map units having names that begin with the same letter, except that it does not separate sloping phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas.

SYMBOL	NAME
Ac	Alcester silt loam
Ar	Arlo clay loam
Ba	Baltic silty clay loam
Bb	Baltic silty clay loam, ponded
BeE	Betts-Ethan loams, 15 to 40 percent slopes
BhE	Betts-Talmo complex, 12 to 40 percent slopes
BkA	Blendon fine sandy loam, 0 to 2 percent slopes
BmB	Blendon-Henkin fine sandy loams, 2 to 6 percent slopes
Ca	Chancellor silty clay loam
Cc	Chaska loam, channeled
Cd	Clamo silty clay
Ce	Clamo clay, gravelly substratum
ChA	Clarno-Bonilla loams, 0 to 2 percent slopes
ChB	Clarno-Bonilla loams, 1 to 6 percent slopes
CkA	Clarno-Crossplain-Davison complex, 0 to 3 percent slopes
CmB	Clarno-Davison loams, 2 to 5 percent slopes
CoB	Clarno-Ethan loams, 2 to 6 percent slopes
CoC	Clarno-Ethan loams, 5 to 9 percent slopes
Cr	Crossplain clay loam
DaA	Davis loam, 0 to 2 percent slopes
DaB	Davis loam, 2 to 6 percent slopes
DbA	Davis loam, sandy substratum, 0 to 2 percent slopes
DeA	Delmont-Enet loams, 0 to 2 percent slopes
DeB	Delmont-Enet loams, 2 to 6 percent slopes
DgB	Dempster-Graceville silty clay loams, 1 to 5 percent slopes
Do	Dimo clay loam
EeA	Egan-Ethan complex, 0 to 2 percent slopes
EeB	Egan-Ethan complex, 2 to 6 percent slopes
EfA	Egan-Trent silty clay loams, 0 to 2 percent slopes
EgB	Egan-Wentworth silty clay loams, 2 to 6 percent slopes
EnA	Enet loam, 0 to 2 percent slopes
EsD	Ethan-Betts loams, 6 to 15 percent slopes
EtB	Ethan-Egan complex, 2 to 6 percent slopes
EtC	Ethan-Egan complex, 5 to 9 percent slopes
HuA	Huntimer silty clay loam, 0 to 2 percent slopes
La	Lamo silty clay loam
Or	Orthents-Aquents complex
Ro	Roxbury silt loam
Rv	Roxbury Variant silt loam
Sa	Salmo silty clay loam
Te	Tetonka silt loam
WaA	Wakonda-Wentworth-Chancellor silty clay loams, 0 to 3 percent slopes
WcA	Wentworth-Chancellor-Wakonda silty clay loams, 0 to 2 percent slopes
Wo	Worthing silty clay loam

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

County or parish

Field sheet matchline & neatline

AD HOC BOUNDARY (label)
Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS

ROADS

ROAD EMBLEMS & DESIGNATIONS

Federal

State

RAILROAD

DAMS

Medium or small

MISCELLANEOUS CULTURAL FEATURES

Farmstead, house (omit in urban areas)

Church

School

WATER FEATURES

DRAINAGE

Perennial, single line

Intermittent

Drainage end

Canals or ditches

Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

Perennial

MISCELLANEOUS WATER FEATURES

Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

Orthents (gravel pit)

TURNER COUNTY, SOUTH DAKOTA — SHEET NUMBER 1

2 790 000 FEET

R. 55 W.

435 000 FEET

MC COOK COUNTY

T. 100 N.

(Joins inset, sheet 6)

(Joins sheet 2)

(Joins sheet 7)

2 810 000 FEET

435 000 FEET

FORMER CHICAGO MILWAUKEE ST. PAUL AND PACIFIC

West Fork

Vermillion River

1 Mile

5000 Feet

Scale 1:20000

N

TURNER COUNTY, SOUTH DAKOTA — SHEET NUMBER 2

2

N

R. 54 W.

2 830 000 FEET

445 000 FEET

T. 100 N.

MC COOK COUNTY

1 Mile

5000 Feet

Scale · 1 : 20000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

435 000 FEET

2 815 000 FEET

(Joins sheet 1)

(Joins sheet 3)

(Joins sheet 8)

Monroe

SEWAGE LAGOON

7 8 9 10 11

18 17 16 15 14

Te CkA Cr CmB Wo ChB ChA CoB CoC EsD DaA DaB Bb Cc

TURNER COUNTY, SOUTH DAKOTA — SHEET NUMBER 3

3

N

2 835 000 FEET

R. 54 W. | R. 53 W.

445 000 FEET

T. 100 N.

MC COOK COUNTY

MINNEHAHA COUNTY

(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 9)

435 000 FEET

2 855 000 FEET

East Fork Vermillion River

Creek

1 Mile

5000 Feet

Scale 1:20000

TURNER COUNTY, SOUTH DAKOTA — SHEET NUMBER 4

4

N

1 Mile

5000 Feet

Scale · 1 : 20000

R. 53 W. | R. 52 W.

2 880 000 FEET

445 000 FEET

MINNEHAHA COUNTY

T. 100 N.

435 000 FEET

2 860 000 FEET

(Joins sheet 3)

(Joins sheet 10)

(Joins sheet 5)

10 11 12 7 8

15 14 13 18 17

Camp Creek

Elce Creek

Long S Creek

TURNER COUNTY, SOUTH DAKOTA — SHEET NUMBER 5

5

N

2 885 000 FEET

R. 52 W.

445 000 FEET

MINNEHAHA COUNTY

T. 100 N.

(Joins sheet 4)

LINCOLN COUNTY

435 000 FEET

2 900 000 FEET

(Joins sheet 11)

1 Mile 5000 Feet

Scale 1:20000

6

N

Scale · 1 : 20000

1 Mile 5000 Feet

MC COOK COUNTY R. 55 W.

2 785 000 FEET

T. 100 N.

435 000 FEET

HUTCHINSON COUNTY

430 000 FEET

2 780 000 FEET

(Joins upper right)

(Joins sheet 1)

(Joins lower left)

R. 55 W.

2 785 000 FEET

425 000 FEET

T. 100 N.

(Joins sheet 7)

415 000 FEET

2 780 000 FEET

(Joins inset, sheet 17)

7

N

2 790 000 FEET

R. 55 W.

(Joins sheet 1)

425 000 FEET

T. 100 N.

(Joins sheet 6)

(Joins sheet 8)

(Joins sheet 12)

2 810 000 FEET

415 000 FEET

1 Mile

5000 Feet

Scale 1:20000

FORMER CHICAGO

MILWAUKEE

ST. PAUL

AND

PACIFIC

West Fork Vermillion River

20 21 22 23 24

29 28 27 26 25

32 33 34 35 36

8

N

(Joins sheet 2)

R. 54 W.

2 830 000 FEET

430 000 FEET

T. 100 N.

(Joins sheet 7)

(Joins sheet 9)

1 Mile

5000 Feet

0 0

Scale 1:20000

1000 2000 3000 4000 5000

¼ ½ ¾ 1

415 000 FEET

(Joins sheet 13)

2 815 000 FEET

19 20 21 22 23

30 29 28 27 26

31 32 33 34 35

ChA ChB CkA CmB CoB CoC Cr EsD Te Wo BeE BhE Ro DeB EfA DaA DaB Ce Ba Bb Do DeA EnA Cc Or

West Fork Vermillion River

SEWAGE LAGOON

Marion

2 835 000 FEET
R. 54 W.
R. 53 W.
(Joins sheet 3)
430 000 FEET
T. 100 N.
(Joins sheet 8)
(Joins sheet 10)
(Joins sheet 14)
2 855 000 FEET
420 000 FEET
23
24
19
20
21
26
25
30
29
28
35
36
31
32
33
East Fork
Vermillion River
N
1 Mile
5,000 Feet
Scale 1:20000

N

(Joins sheet 4)

R. 53 W. | R. 52 W.

2 880 000 FEET

430 000 FEET

T. 100 N.

(Joins sheet 11)

(Joins sheet 9)

420 000 FEET

2 860 000 FEET

(Joins sheet 15)

Scale · 1:20000

1 Mile

5000 Feet

Elce Creek

Camp Creek

Long Creek

East Fork Vermillion R.

22 23 24 19 20

27 26 25 30 29

34 35 36 31 32

EsD EgB EfA EeB Te Ca Cc EtC Wo WcA La DeB Bb Ba Ac DaA Ro BkA Or DeA BeE CoB

N

2 885 000 FEET

R. 52 W.

(Joins sheet 5)

430 000 FEET

T. 100 N.

(Joins sheet 10)

LINCOLN COUNTY

Scale 1:20000

1 Mile

5000 Feet

420 000 FEET

2 905 000 FEET

(Joins sheet 16)

N

Scale 1:20000

1 Mile 5000 Feet

(Joins sheet 7)

R. 55 W.

2 810 000 FEET

410 000 FEET

T. 99 N.

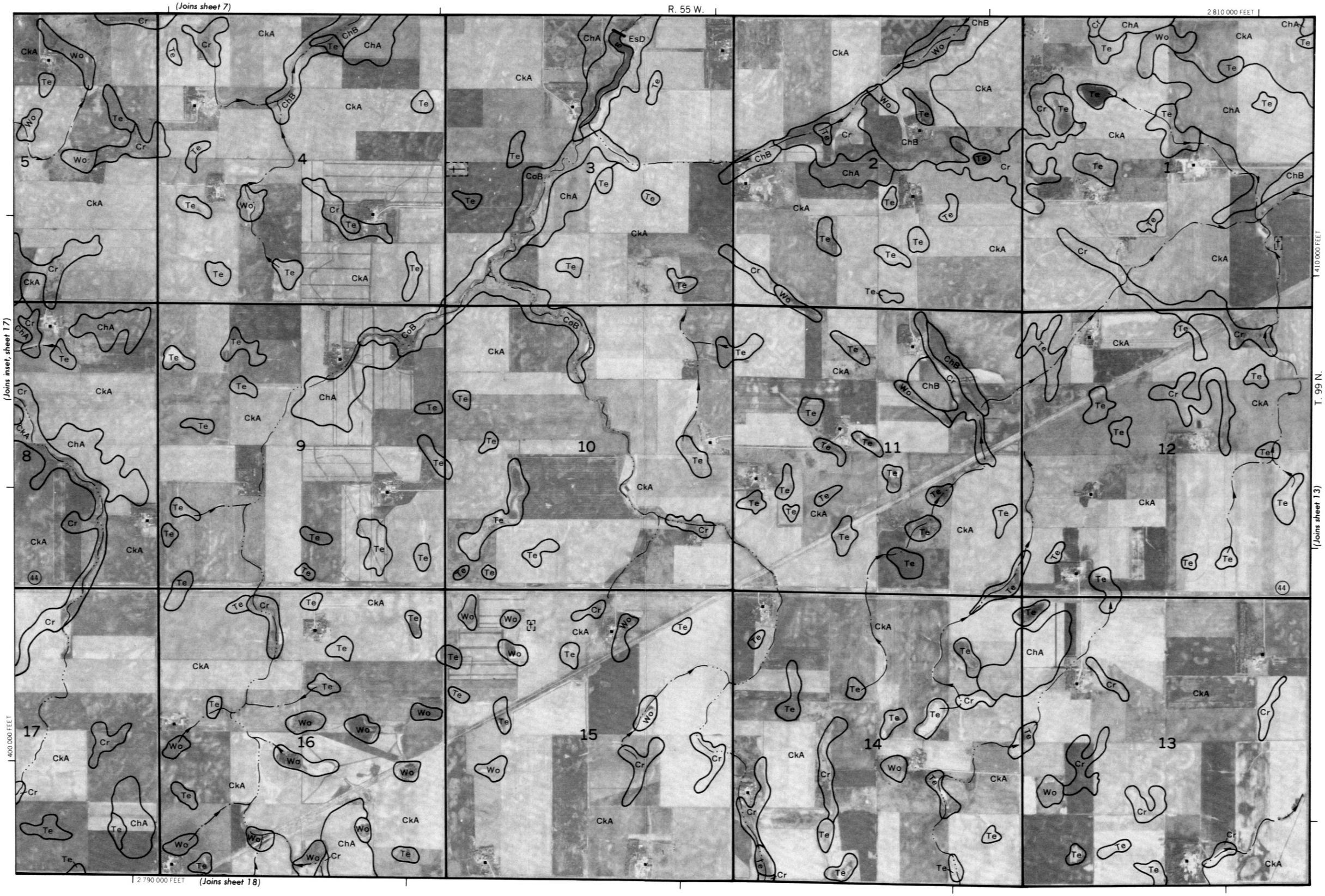
(Joins inset, sheet 17)

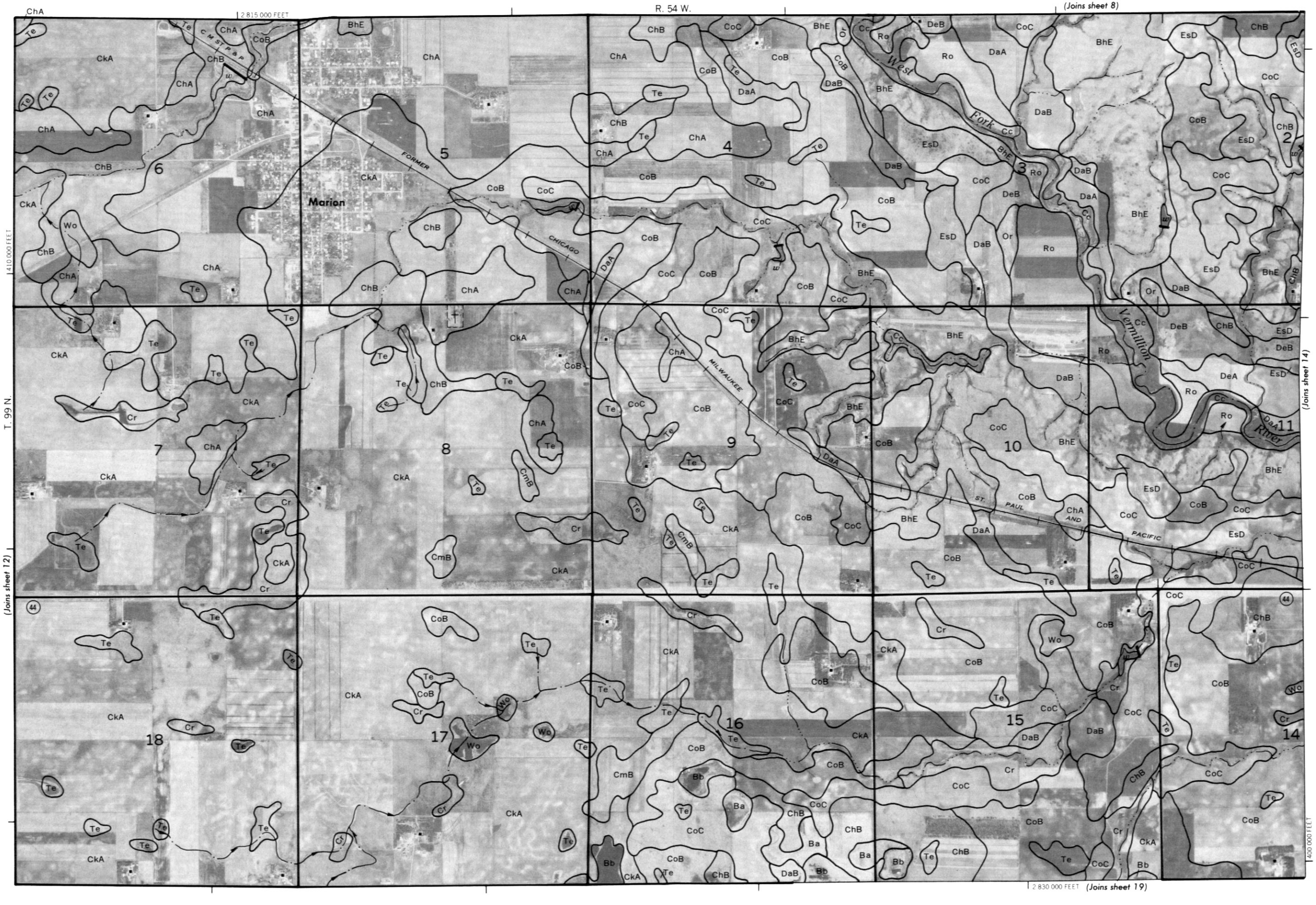
400 000 FEET

2 790 000 FEET

(Joins sheet 18)

(Joins sheet 13)




R. 54 W.
(Joins sheet 8)
2 815 000 FEET
410 000 FEET
T. 99 N.
(Joins sheet 12)
Marion
CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC
FORMER CHICAGO, MILWAUKEE, ST. PAUL AND PACIFIC
West Fork Vermillion River
(Joins sheet 14)
2 830 000 FEET
(Joins sheet 19)
400 000 FEET
N
1 Mile
5000 Feet
Scale 1:20000

N

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 9)

R. 54 W. | R. 53 W.

2 855 000 FEET

415 000 FEET

T. 99 N.

(Joins sheet 13)

(Joins sheet 15)

400 000 FEET

(Joins sheet 20)

2 840 000 FEET

West Fork Vermillion River

CHICAGO MILWAUKEE ST. PAUL AND PACIFIC

PARKER (county seat)

SEWAGE LAGOON

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

2 860 000 FEET

R. 53 W. | R. 52 W.

(Joins sheet 10)

415 000 FEET

T. 99 N.

(Joins sheet 14)

(Joins sheet 16)

405 000 FEET

(Joins sheet 21)

2 880 000 FEET

N

1 Mile

5000 Feet

Scale 1:20000

0 1000 2000 3000 4000 5000

¼ ½ ¾ 1

Camp Creek

Elce Creek

East Fork Vermillion River

West Fork Vermillion River

Camp Creek

Creek

FORMER CHICAGO MILWAUKEE ST. PAUL AND PACIFIC

1944

N

R. 52 W.

(Joins sheet 11)

(Joins sheet 15)

2 905 000 FEET

415 000 FEET

405 000 FEET

2 885 000 FEET (Joins sheet 22)

T. 99 N.

LINCOLN COUNTY

Scale 1:20000

1 Mile 0 ¼ ½ ¾ 1

5000 Feet 0 1000 2000 3000 4000 5000

Long Creek

N

2 780 000 FEET (Joins inset, sheet 6) R. 55 W.

410 000 FEET

T. 99 N.

HUTCHINSON COUNTY

(Joins sheet 12)

400 000 FEET

(Joins upper right) 2 785 000 FEET

2 781 000 FEET (Joins lower left) R. 55 W.

395 000 FEET

T. 99 N.

HUTCHINSON COUNTY

(Joins sheet 18)

385 000 FEET

(Joins inset, sheet 28) 2 786 000 FEET

1 Mile

5000 Feet

Scale 1:20000

N

Scale · 1:20000

1 Mile 5000 Feet

0 0 1000 ¼ 2000 ⅜ 3000 ½ 4000 ¾ 5000 1

(Joins sheet 12) R. 55 W. 2 810 000 FEET

395 000 FEET

T. 99 N.

(Joins sheet 19)

(Joins sheet 17)

385 000 FEET

2 790 000 FEET (Joins sheet 23)

20 21 22 23 24

29 28 27 26 25

32 33 34 35 36

Te CkA Cr ChA Wo ChB CmB Bb CoB

2 815 000 FEET

R. 54 W.

(Joins sheet 13)

395 000 FEET

T. 99 N.

(Joins sheet 18)

(Joins sheet 20)

(Joins sheet 24)

385 000 FEET

2 835 000 FEET

N

1 Mile

5000 Feet

Scale 1:20000

North Fork Hurley Creek

South Fork Hurley Creek

N

(Joins sheet 14)

R. 54 W. | R. 53 W.

2 855 000 FEET

400 000 FEET

T. 99 N.

(Joins sheet 21)

(Joins sheet 19)

385 000 FEET

(Joins sheet 25) | 2 840 000 FEET

1 Mile 5 000 Feet

Scale 1:20000

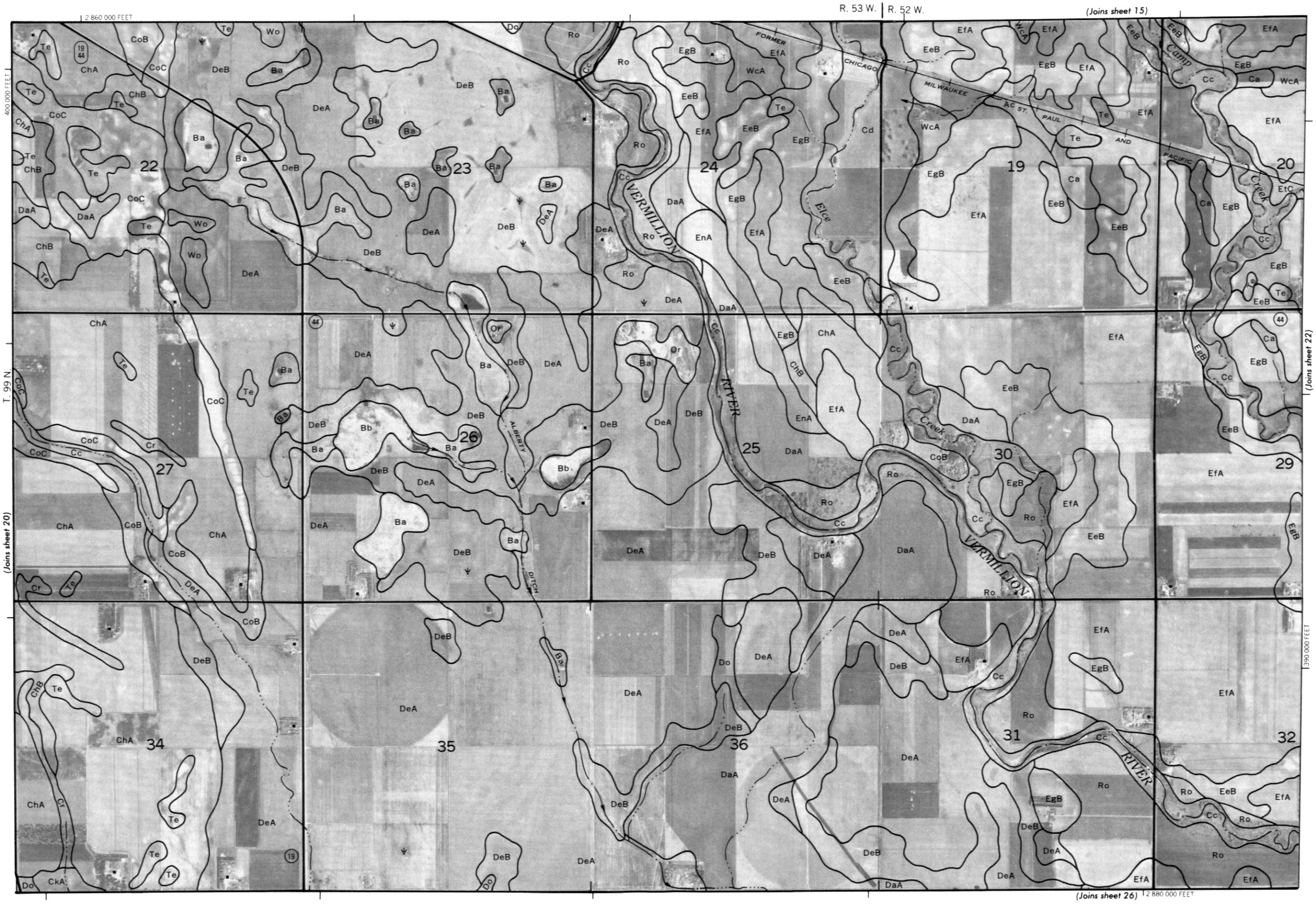
0 0 ¼ 1 000 ½ 2 000 ¾ 3 000 1 5 000 4 000

23 24 19 20 21

26 25 30 29 28

35 36 31 32 33

North Fork South Fork Firesteel Cr Hurley Creek


2 860 000 FEET
400 000 FEET
R. 53 W.
R. 52 W.
(Joins sheet 15)
T. 99 N.
(Joins sheet 20)
(Joins sheet 22)
(Joins sheet 26)
2 880 000 FEET
390 000 FEET
FORMER CHICAGO MILWAUKEE AND ST. PAUL AND PACIFIC
VERMILLION RIVER
Elce Creek
Camp Creek
ALBERTT DITCH
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
Scale 1:20000
1 Mile
5 000 Feet
N

N

(Joins sheet 16)

R. 52 W.

2 905 000 FEET

400 000 FEET

T. 99 N.

LINCOLN COUNTY

Scale · 1:20000

1 Mile 0 5000 Feet

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

5 000

390 000 FEET

2 885 000 FEET

(Joins sheet 27)

(Joins sheet 21)

Chancellor

SEWAGE LAGOON

FORMER CHICAGO MILWAUKEE ST. PAUL AND PACIFIC

Long Creek

Camp Creek

VEIR R.

20 21 22 23 24 25 26 27 28 29 32 33 34 35 36

EfA EgB WcA EeB EsD Te Ca Wo EtC Cc Or La DgB DeB Cd Ba DaA Ro

2 790 000 FEET

380 000 FEET

R. 55 W.

(Joins sheet 18)

T. 98 N.

(Joins inset, sheet 28)

(Joins sheet 24)

(Joins sheet 29)

2 810 000 FEET

370 000 FEET

N

1 Mile

5000 Feet

Scale 1:20000

0 0 1000 2000 3000 4000 5000

¼ ½ ¾ 1

N

(Joins sheet 19)

R. 54 W.

2 835 000 FEET

(Joins sheet 23)

T. 98 N.

380 000 FEET

(Joins sheet 25)

320 000 FEET

2 815 000 FEET

(Joins sheet 30)

1 Mile

5000 Feet

Scale · 1 : 20000

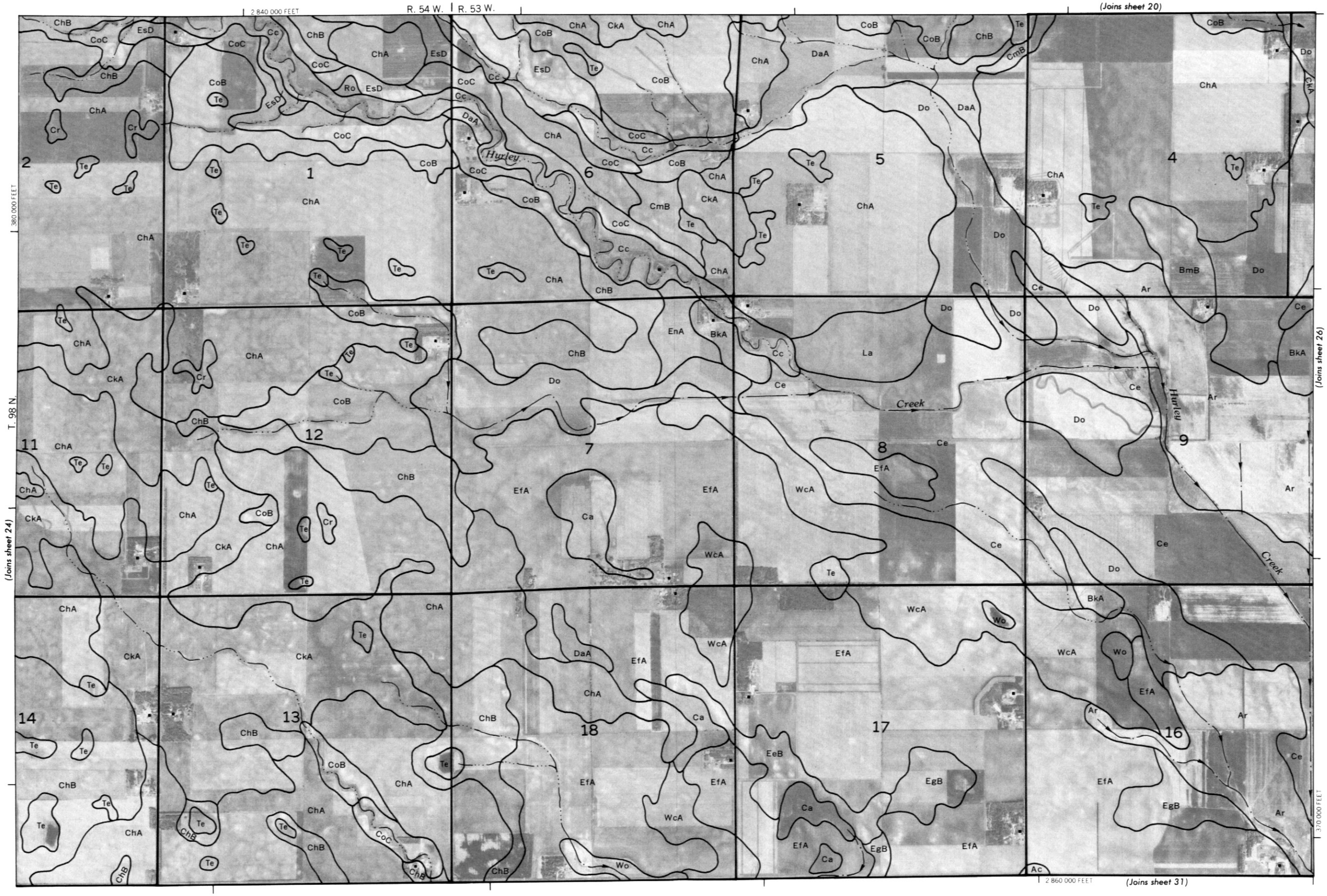
0 0 ¼ 1000 ½ 2000 ¾ 3000 1 4000 5000

6 5 4 3 2

7 8 9 10 11

18 17 16 15 14

CkA ChA ChB CoB CoC Te Wo Cr Cc DaA EsD Ba


2 840 000 FEET
R. 54 W.
R. 53 W.
(Joins sheet 20)
380 000 FEET
T. 98 N.
(Joins sheet 24)
(Joins sheet 26)
370 000 FEET
2 860 000 FEET
(Joins sheet 31)
Hurley
Creek
Hurley Creek
1
2
4
5
6
7
8
9
11
12
13
14
16
17
18
ChB
CoC
EsD
ChA
CoB
Te
Cr
Cc
Ro
DaA
CkA
CmB
Do
Ce
Ar
BmB
BkA
EnA
La
EfA
WcA
Ca
EgB
EeB
Wo
Ac
N
1 Mile
5000 Feet
Scale 1:20000

N

1 Mile 5000 Feet

Scale 1:20000

(Joins sheet 21)

R. 53 W. | R. 52 W.

2 880 000 FEET

385 000 FEET

T. 98 N.

(Joins sheet 25)

(Joins sheet 27)

370 000 FEET

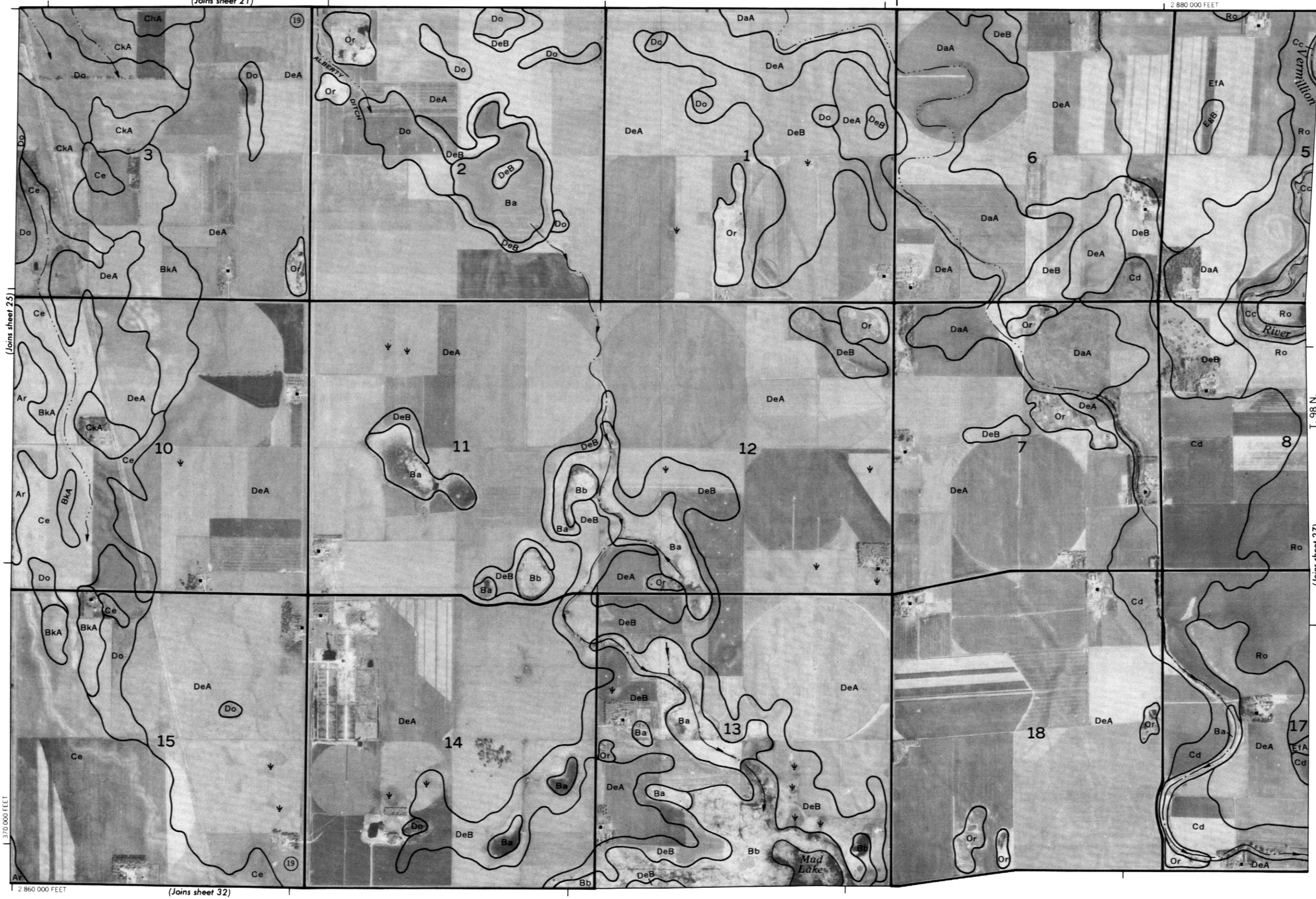
2 860 000 FEET

(Joins sheet 32)

Vermillion River

Mad Lake

ALBERTY DITCH



2 885 000 FEET

R. 52 W.

(Joins sheet 22)

385 000 FEET

T. 98 N.

(Joins sheet 26)

(Joins sheet 33)

2 905 000 FEET

375 000 FEET

LINCOLN COUNTY

N

1 Mile

5000 Feet

Scale 1:20000

Vermillion River

VERMILLION River

NORTHERN

BURLINGTON

Ro Cc EeB EfA WcA Te Ca Wo DgB DeA Cd Wp

1 2 3 4 5 8 9 10 11 12 13 14 15 16 17

28

N

Scale 1:20000

1 Mile 5000 Feet

0 0

¼ 1000

½ 2000

¾ 3000

1 4000 5000

(Joins inset, sheet 17) R. 55 W. 2 786 000 FEET

380 000 FEET

T. 98 N.

HUTCHINSON COUNTY

370 000 FEET

2 781 000 FEET

(Joins sheet 23)

(Joins upper right)

(Joins lower left) R. 55 W. 2 787 000 FEET

365 000 FEET

T. 98 N.

355 000 FEET

2 782 000 FEET

(Joins sheet 29)

(Joins inset, sheet 39)

Turkey Ridge Creek

2 790 000 FEET

R. 55 W.

(Joins sheet 23)

365 000 FEET

T. 98 N.

(Joins sheet 30)

(Joins sheet 28)

355 000 FEET

(Joins sheet 34)

2 810 000 FEET

N

1 Mile

5000 Feet

Scale 1:20000

Turkey Ridge Creek

N

Scale 1:20000

1 Mile 5000 Feet

0 0 ¼ 1 000 ½ 2 000 ¾ 3 000 1 4 000 5 000

(Joins sheet 24)

R. 54 W.

2 835 000 FEET

365 000 FEET

T. 98 N.

(Joins sheet 29)

(Joins sheet 31)

355 000 FEET

2 815 000 FEET

(Joins sheet 35)

19 20 21 22 23

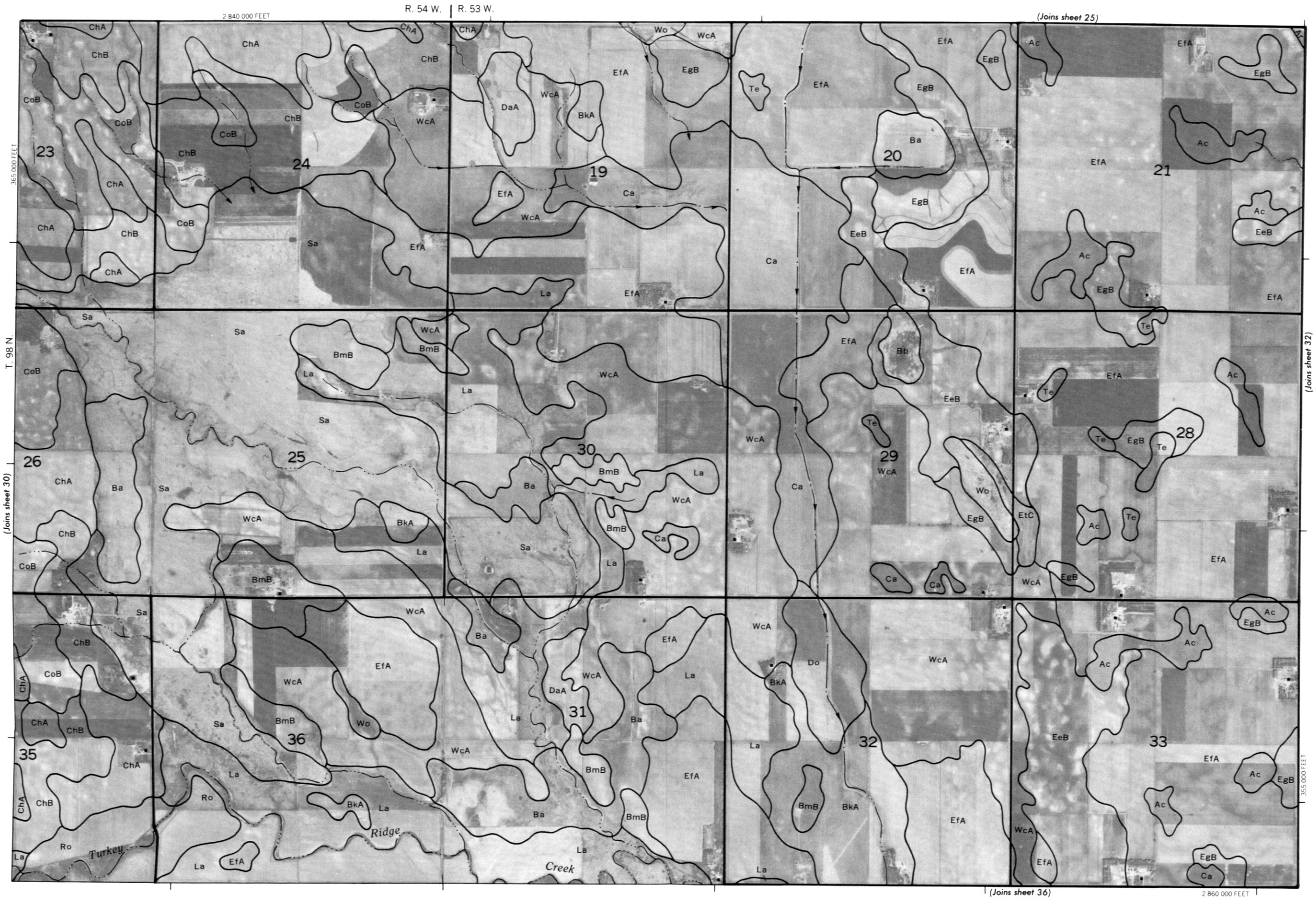
30 29 28 27 26

31 32 33 34 35

Turkey Creek

Ridge Creek

Turkey Ridge Creek



31

N

1 Mile
5,000 Feet

Scale 1:20000

0 0 1/4 1000 1/2 2000 3/4 3000 1 4000 5000

32

N

(Joins sheet 26)

R. 53 W. | R. 52 W.

2 880 000 FEET

370 000 FEET

T. 98 N.

(Joins sheet 31)

(Joins sheet 33)

(Joins sheet 37)

2 865 000 FEET

355 000 FEET

1 Mile

5 000 Feet

Scale · 1 : 20000

Hurley

Lake Mud

Hurley Creek

Creek

19 20 22 23 24 27 26 25 30 29 34 35 36 31 32

2 885 000 FEET

R. 52 W.

(Joins sheet 27)

370 000 FEET

T. 98 N.

(Joins sheet 32)

20 21 22 23 24

29 28 27 26 25

32 33 34 35 36

Vermillion River

NORTHERN

BURLINGTON

Davis

LINCOLN COUNTY

360 000 FEET

(Joins sheet 38)

2 905 000 FEET

33

N

1 Mile

5000 Feet

Scale 1:20000

N

(Joins sheet 29)

R. 55 W.

2 810 000 FEET

350 000 FEET

T. 97 N.

(Joins inset, sheet 39)

(Joins sheet 35)

1 Mile

5000 Feet

Scale 1:20000

335 000 FEET

(Joins sheet 40)

2 795 000 FEET

Turkey Ridge

N

2 815 000 FEET

R. 54 W.

(Joins sheet 30)

350 000 FEET

T. 97 N.

(Joins sheet 34)

(Joins sheet 36)

340 000 FEET

(Joins sheet 41)

2 835 000 FEET

Turkey Ridge Creek

Scale 1:20000

1 Mile 5000 Feet

N

R. 54 W. | R. 53 W.

(Joins sheet 31)

2 860 000 FEET

350 000 FEET

T. 97 N.

(Joins sheet 35)

340 000 FEET

2 840 000 FEET

(Joins sheet 42)

(Joins sheet 37)

Scale · 1 : 20000

1 Mile

5000 Feet

Turkey Ridge Creek

Swan Lake

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

2 865 000 FEET

R. 53 W. | R. 52 W.

(Joins sheet 32)

350 000 FEET

T. 97 N.

(Joins sheet 36)

(Joins sheet 38)

(Joins sheet 43)

2 880 000 FEET

N

1 Mile

5 000 Feet

Scale 1:20000

340 000 FEET

Hurley Creek

Vermillion R.

Turkey Ridge Creek

Swan Lake

NORTHERN

BURLINGTON

MEARS DITCH

N

1 Mile 5000 Feet

Scale · 1:20000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

(Joins sheet 33)

R. 52 W.

2 905 000 FEET

355 000 FEET

(Joins sheet 37)

340 000 FEET

2 885 000 FEET

(Joins sheet 44)

T. 97 N.

LINCOLN COUNTY

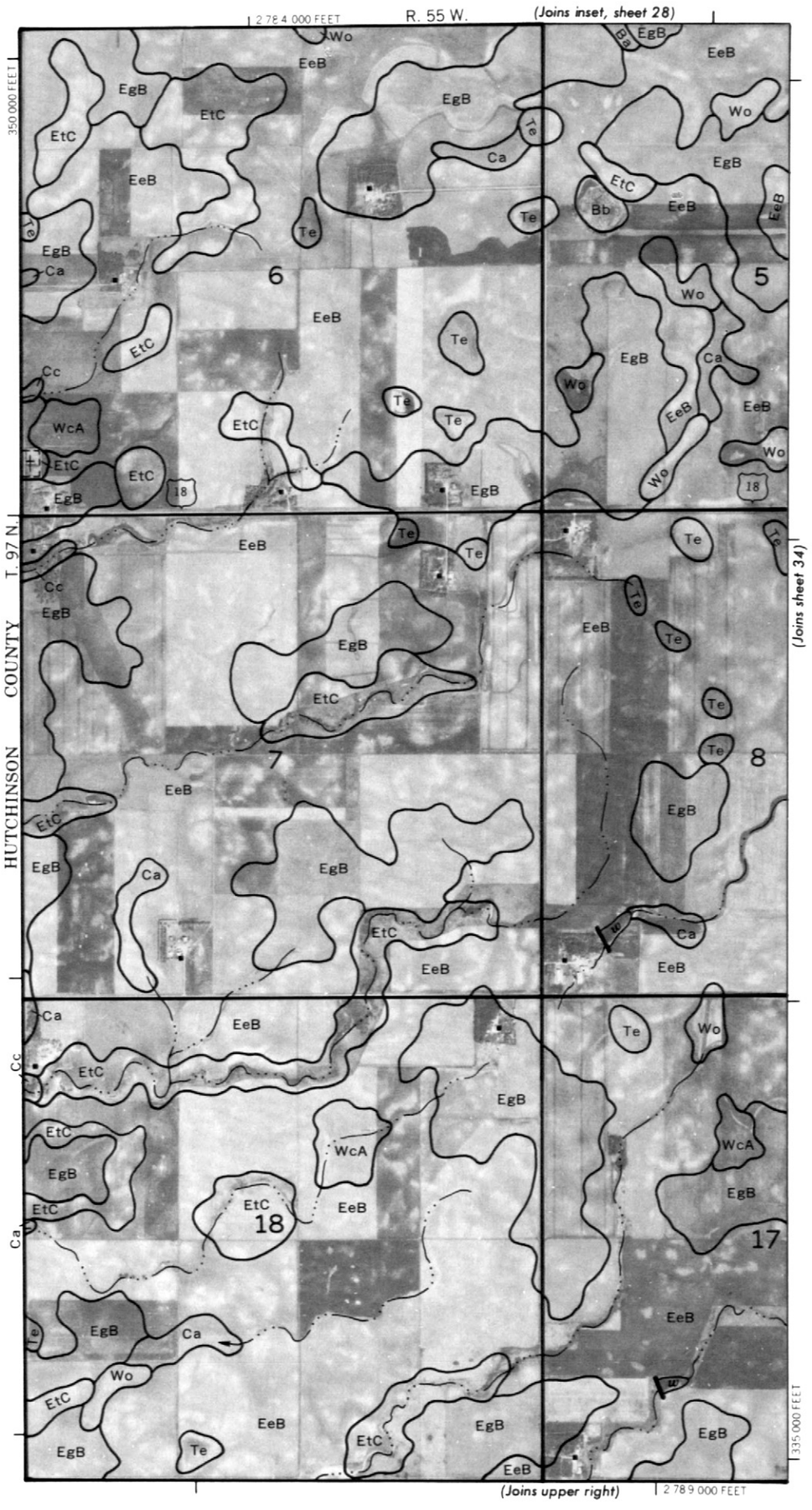
VERMILLION RIVER

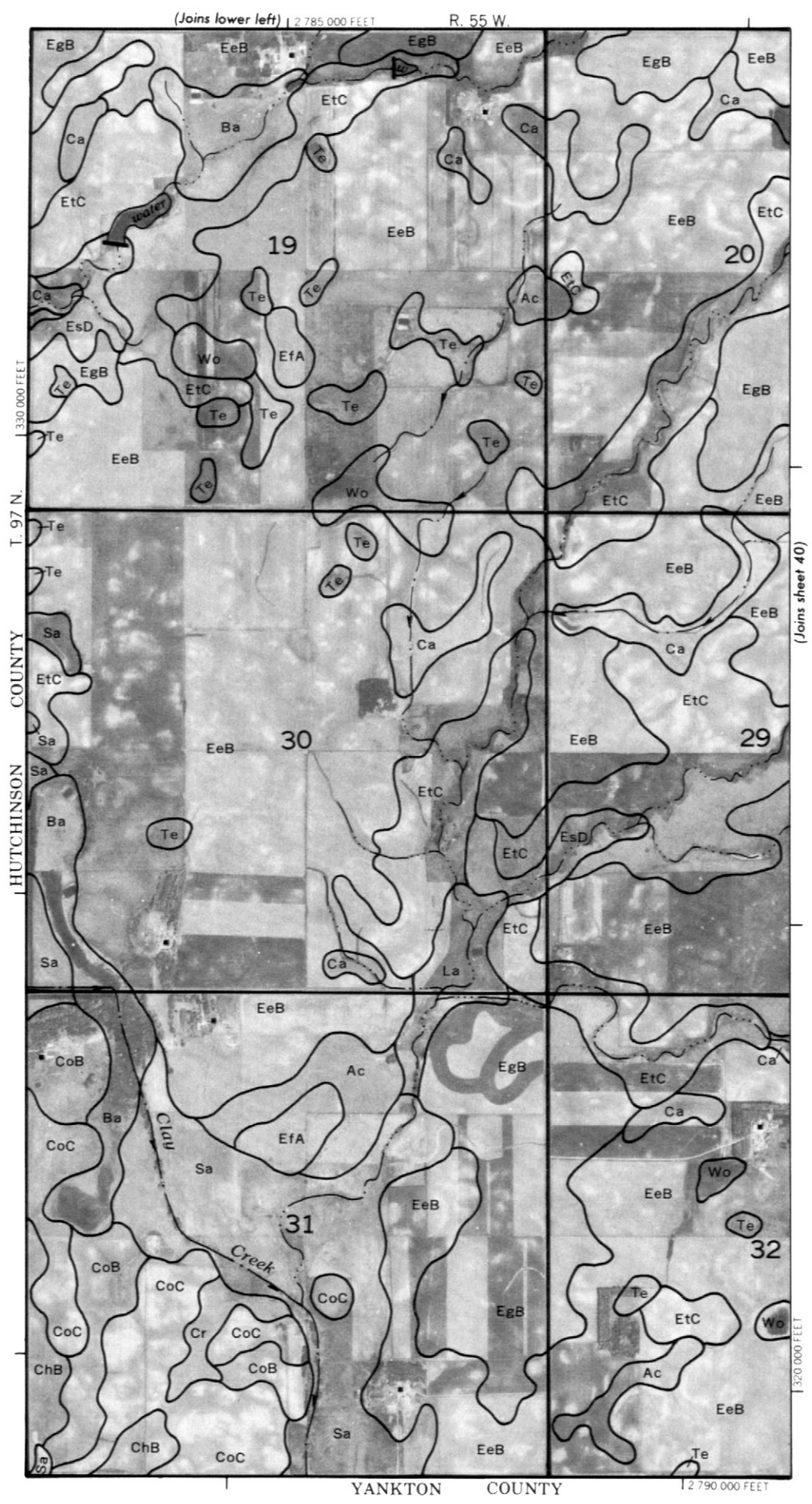
NORTHERN

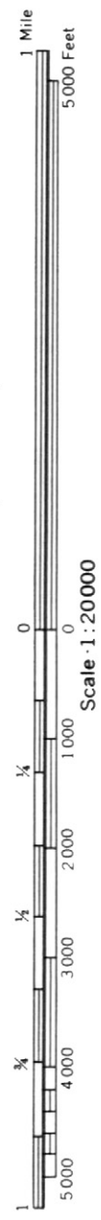
BURLINGTON

Davis

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17


(Joins inset, sheet 28)
2 784 000 FEET
R. 55 W.
350 000 FEET
T. 97 N.
HUTCHINSON COUNTY
(Joins sheet 34)
335 000 FEET
(Joins upper right)
2 789 000 FEET
6
5
7
8
18
17
EgB
EeB
EtC
Te
Wo
Ca
Cc
WcA
Ba
Bb


(Joins lower left)
2 785 000 FEET
R. 55 W.
330 000 FEET
T. 97 N.
HUTCHINSON COUNTY
(Joins sheet 40)
320 000 FEET
2 790 000 FEET
YANKTON COUNTY
19
20
30
29
31
32
water
Clay Creek
EgB
EeB
EtC
Te
Wo
Ca
Ba
EsD
EfA
Ac
Sa
CoB
CoC
ChB
Cr
La


N
1 Mile
5,000 Feet
Scale 1:20000
0
1 000
2 000
3 000
4 000
5 000

40

N

(Joins sheet 34)

R. 55 W.

2 810 000 FEET

335 000 FEET

T. 97 N.

(Joins sheet 39)

(Joins sheet 41)

1 Mile 5000 Feet

Scale 1:20000

320 000 FEET

2 795 000 FEET

YANKTON COUNTY

Pearsons Corner

Turkey Creek

R. 54 W.

(Joins sheet 35)

2 815 000 FEET

335 000 FEET

T. 97 N.

(Joins sheet 40)

(Joins sheet 42)

325 000 FEET

2 835 000 FEET

N

1 Mile

5000 Feet

Scale 1:20000

0 1/4 1/2 3/4 1

0 1000 2000 3000 4000 5000

Turkey Creek

Center Point

YANKTON COUNTY

N

(Joins sheet 36)

R. 54 W. | R. 53 W.

2 860 000 FEET

335 000 FEET

T. 97 N.

(Joins sheet 41)

325 000 FEET

2 840 000 FEET

YANKTON COUNTY

(Joins sheet 45)

(Joins sheet 43)

1 Mile

5000 Feet

Scale · 1 : 20000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

23 24 19 20 21

26 25 30 29 28

35 36 31 32 33

EfA EeB EgB EtC Te Ca Ac Ba Bb Wo WcA Sa Do DgB DaB EsD Or La

N

R. 53 W. | R. 52 W.

2 865 000 FEET

335 000 FEET

T. 97 N.

(Joins sheet 37)

(Joins sheet 44)

(Joins sheet 42)

(Joins sheet 46)

325 000 FEET

2 885 000 FEET

Turkey Ridge

Creek

NORTHERN

BURLINGTON

MEARS DITCH

SEWAGE LAGOON

Viborg

Hooker

22 23 24 19 20

27 26 25 30 29

34 35 36 31 32

1 Mile

5000 Feet

Scale 1:20000

N
1 Mile
5000 Feet
Scale · 1:20000
0
¼
½
¾
1
1000
2000
3000
4000
5000
R. 52 W.
(Joins sheet 38)
2 905 000 FEET
335 000 FEET
T. 97 N.
LINCOLN COUNTY
(Joins sheet 43)
325 000 FEET
2 890 000 FEET
(Joins sheet 47)
Vermillion River
MEARS DITCH
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
WcA
EeB
EfA
Ca
Te
WaA
Wo
EgB
Ba
Ro
Rv
Cd
Cc
EsD
DaB
DbA
Do
Ce
Bb

45

2 850 000 FEET

(Joins sheet 42)

R. 53 W.

320 000 FEET

T. 95 N.

YANKTON COUNTY

(Joins sheet 46)

310 000 FEET

(Joins sheet 48)

2 860 000 FEET

N

1 Mile

5 000 Feet

Scale 1 : 20000

1 0 1/4 1/2 3/4 1 000 2 000 3 000 4 000 5 000

N

Scale · 1 : 20000

1 Mile | 5000 Feet | 1000 | 2000 | 3000 | 4000 | 5000

R. 53 W. | R. 52 W.

2 885 000 FEET

320 000 FEET

310 000 FEET

2 865 000 FEET

T. 96 N.

(Joins sheet 43)

(Joins sheet 45)

(Joins sheet 47)

(Joins sheet 49)

Viborg

NORTHERN

BURLINGTON

KLEFKE DITCH

Turkey Ridge Creek

Turkey Ridge Creek

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

EfA EeB EeA EgB EtC Te Ca Or DgB DaB La EsD BeF WcA Wo Ba Bb Sa Ac WaA HuA DeB

2 890 000 FEET

R. 52 W.

(Joins sheet 44)

320 000 FEET

T. 96 N.

(Joins sheet 46)

N

1 Mile

5000 Feet

Scale 1:20000

LINCOLN COUNTY

310 000 FEET

(Joins sheet 50)

2 910 000 FEET

(48)

N

Scale · 1 : 20000

1 Mile 5000 Feet

0 0 ¼ ½ ¾ 1

1000 2000 3000 4000 5000

(Joins sheet 45)

R. 53 W.

2 860 000 FEET

305 000 FEET

T. 96 N.

YANKTON COUNTY

NORTHERN

BURLINGTON

Creek

Irene

(Joins sheet 49)

290 000 FEET

2 840 000 FEET

CLAY COUNTY

19 20 21 30 29 28 31 32 33

EsD EeB Ba Ac Ca EgB Wo EtC Cc Sa La WcA Te Bb EfA

(46)

2,865,000 FEET

305,000 FEET

R. 53 W. | R. 52 W.

(Joins sheet 46)

T. 96 N.

(Joins sheet 48)

(Joins sheet 50)

Frog Creek

KLEPKE DITCH

1 Mile 5,000 Feet

Scale 1:20000

CLAY COUNTY

2,885,000 FEET

50

N

Scale 1:20000

1 Mile 5000 Feet

0 0 1/4 1000 2000 1/2 3000 4000 3/4 5000 1

(Joins sheet 47)

R. 52 W.

2 910 000 FEET

305 000 FEET

T. 96 N.

(Joins sheet 49)

295 000 FEET

2 890 000 FEET

CLAY COUNTY

LINCOLN COUNTY

Centerville

VERMILLION RIVER

Turkey Ridge Creek

Turkey La Creek R

BONINE DITCH

Blind Creek

20 21 22 23 24 25 26 27 28 29 32 33 34 35 36